4027

Tarawa/Wasp Class

Assault Ships *in action*

Squadron Signal Publications

Warships Number 27

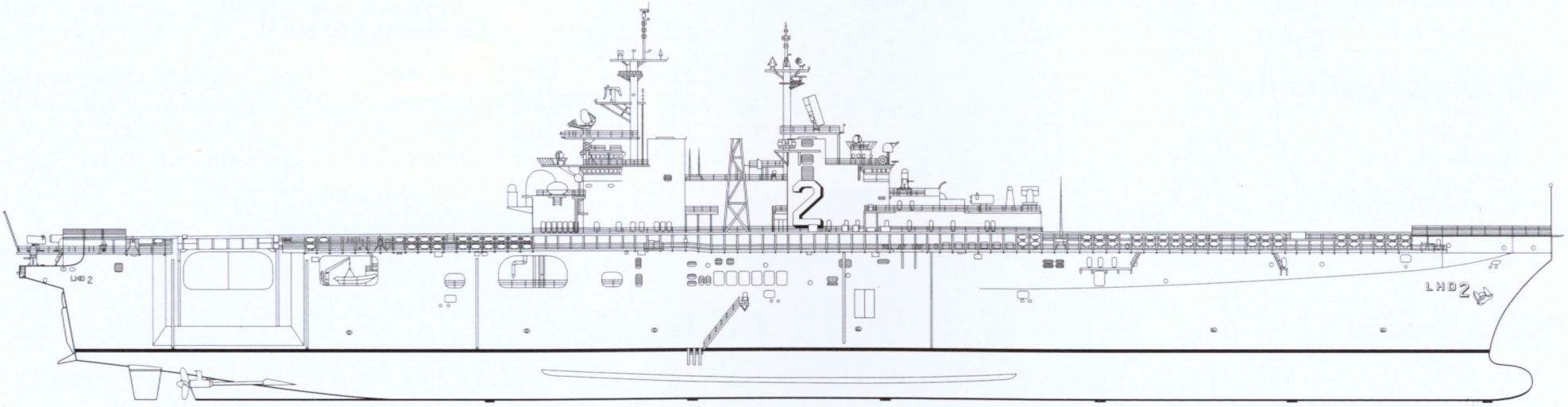
Don Greer 2006

Tarawa/Wasp Class
Assault Ships *in action*

By John Gourley

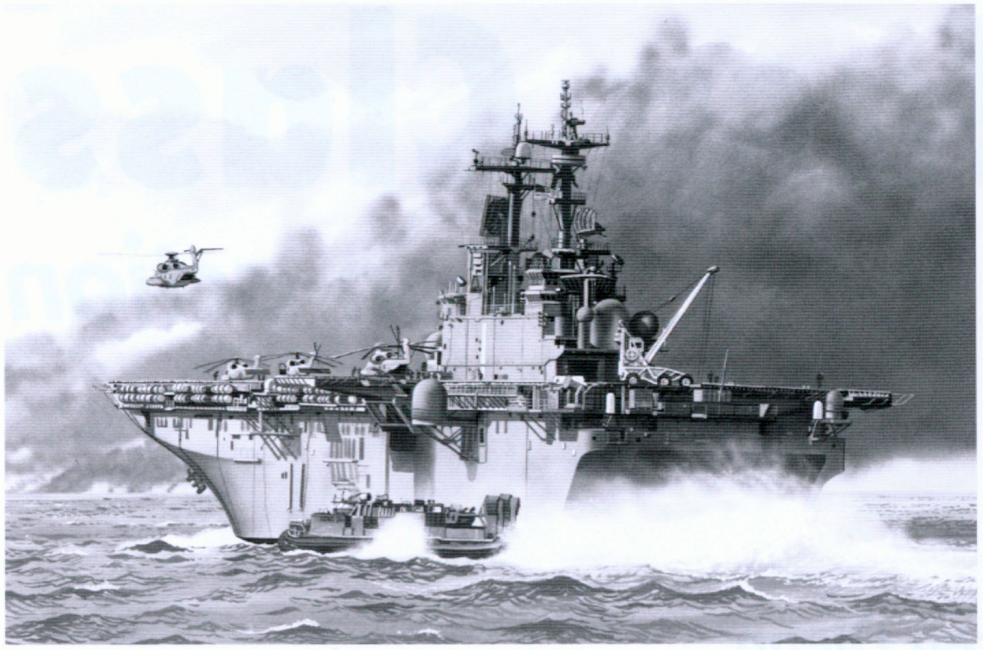
Color by Don Greer

Line art by David Gebhardt and Darren Glenn



Squadron Signal Publications

Warships Number 27



Cover: Smoke from burning oil wells obscures the skies over the Persian Gulf as an LCAC (Landing Craft, Air Cushioned) and CH-53E depart USS *Tarawa* (LHA-1) for shore facilities in Kuwait during Operation Desert Storm, 1991. (Original painting by Don Greer)

COPYRIGHT 2006 SQUADRON/SIGNAL PUBLICATIONS
1115 CROWLEY DRIVE CARROLLTON, TEXAS 75011-5010
All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form by means electrical, mechanical or otherwise, without written permission of the publisher.

ISBN 0-89747-502-X

If you have any photographs of aircraft, armor, soldiers or ships of any nation, particularly wartime snapshots, why not share them with us and help make Squadron/Signal's books all the more interesting and complete in the future? Any photograph sent to us will be copied and the original returned. The donor will be fully credited for any photos used. Please send them to:

Squadron/Signal Publications, Inc.
1115 Crowley Drive
Carrollton, TX 75011-5010

Если у вас есть фотографии самолетов, вооружения, солдат или кораблей любой страны, особенно, снимки времен войны, поделитесь с нами и помогите сделать новые книги издательства Эскадрон/Сигнал еще интереснее. Мы переснимем ваши фотографии и вернем оригиналы. Имена приславших снимки будут сопровождать все опубликованные фотографии. Пожалуйста, присылайте фотографии по адресу:

Squadron/Signal Publications, Inc.
1115 Crowley Drive
Carrollton, TX 75011-5010

軍用機、装甲車両、兵士、軍艦などの写真を所持しておられる方はいらっしゃいませんか？どの国のものでも結構です。作戦中に撮影されたものが特に良いのです。Squadron/Signal社の出版する刊行物において、このような写真は内容を一層充実し、興味深くすることができます。当方にお送り頂いた写真は、複写の後お返しいたします。出版物中に写真を使用した場合は、必ず提供者のお名前を明記させて頂きます。お写真は下記にご送付ください。

Squadron/Signal Publications, Inc.
1115 Crowley Drive
Carrollton, TX 75011-5010

Acknowledgements

Lou Drendel
A.D. Baker III
U.S. Naval Institute
Dr. Norman Friedman
Stefan Terzibaschitsch
The crews of USS *Nassau* (LHA-4) and USS *Bataan* (LHD-5)

Photo Credits

John Gourley
Northrop Grumman Ship Systems
U.S. Navy

Dedication:

To those in the "'Gator Navy" who work daily to ensure this nation is able to employ the unique concepts of amphibious operations worldwide.

▸ USS *Kearsarge* (LHD-3) and LCACs of Assault Craft Unit 4 (ACU-4) practice steering maneuvers somewhere in the Atlantic in September 2005.

Amphibious Warfare

From the earliest days of warfare, attacks from the sea usually were limited and generally ineffective due to logistical problems and a lack of equipment suited to the task. Coastlines were accepted as barriers to any attempts to wage war by using the oceans to stage, assemble, and deploy troops against an enemy.

As technology and tactics evolved, often under fire, invasion from the sea became a useful option, because it forced the enemy to dedicate assets to shore defense. This in turn reduced the number of troops available on shore and inland. Used in combination with land forces, amphibious attacks aided in wearing down the overall resistance an enemy could muster, as he now had to defend on two fronts.

As the tactics of amphibious warfare evolved in the United States in the late 1930s, the technology also began to improve. Ships were modified or constructed to carry large numbers of troops and the landing craft that would take the troops ashore under hostile fire. Other ships were necessary for the transportation of the ever-increasing supplies required for the effective conduct of modern warfare for sustained periods. Everything had to go by sea — tanks, artillery, ammunition, clothing, food, water — and everything had to be correctly loaded so that the most important items could be unloaded first for deployment in the field. Landing craft were improved with newly designed hull shapes that allowed them to beach on the shore for unloading, then extract themselves to return to the convoy for restocking of equipment and supplies. Landing craft also were given armor plate to protect troops against small arms fire as they were taken ashore in waves while the objectives were being neutralized.

The mention of amphibious warfare tactics inevitably reminds one of the images of troops wading ashore under fire at the beaches of Normandy, France, on 6 June 1944 — the famous 'D-Day' invasion. Such operations in the latter half of the Twentieth Century were a valued and tried method of attacking enemy forces where coastlines existed. After the initial assault secured a toehold on land, the succeeding waves of troops were able to expand deeper inland as transport ships beached themselves to unload heavy equipment under the protection of friendly air and naval fire support. Supplies were then unloaded and rushed to the front-line soldiers in contact with hostile forces.

To insure the landing operation was successful, capital ships of the surface fleet accompanied the transports to regions of conflict. Aircraft carriers launched waves of aircraft, and battleships, cruisers, and destroyers carried out a pre-landing naval bombardment to 'soften up' shore defenses. Underwater demolition teams (UDTs) conducted reconnaissance of the beaches, exploding mines and removing or identifying obstacles to clear the way so troops and landing craft could assault the beach areas quickly. While landing maneuvers were underway, aircraft provided close support to troops engaged with the enemy, and heavy guns on warships offshore hit pinpoint targets both onshore and inland. During World War II, amphibious assaults in the Atlantic theater at Salerno and Normandy were vital to the overall success of the strategy undertaken by the allied powers. The Pacific war was won by 'island-hopping' amphibious campaigns, including those at Guadalcanal, Tarawa, Kwajalein, Saipan, Peleliu, Iwo Jima, and Okinawa. Just a few years later, the bold amphibious landing at Inchon changed the tempo and eventual outcome of the Korean War.

The threat of attack by sea is also an effective diversionary tactic. The most recent example was the Marine Corps buildup during Operation Desert Storm in 1991. Amphibious forces deployed and practiced maneuvers in the Persian Gulf, implying that an amphibious assault would occur as part of combat operations. Iraqi forces in occupied Kuwait expended much effort and resources fortifying beaches to repel any attacks from the Persian Gulf. As Desert Storm unfolded, amphibious assets were held back, while a large land-based armored force, attacking from the south and west, succeeded in liberating Kuwait. The job would have been a lot tougher had Iraqi resources committed to shore defense been deployed instead to defend Kuwait exclusively against a coalition land attack. The threat of an attack from offshore played a crucial part in the eventual victory.

In the 1960s and 1970s, with military budgets shrinking and streamlining the armed forces of paramount concern, new ship designs were offered to integrate the functions of amphibious warfare on fewer platforms. This offered economy plus consolidation of assets. Amphibious ships were designed from the outset with landing facilities for helicopters, well decks for handling smaller landing craft, and command and communications capabilities to serve the landing force commander as well as to coordinate naval activities.

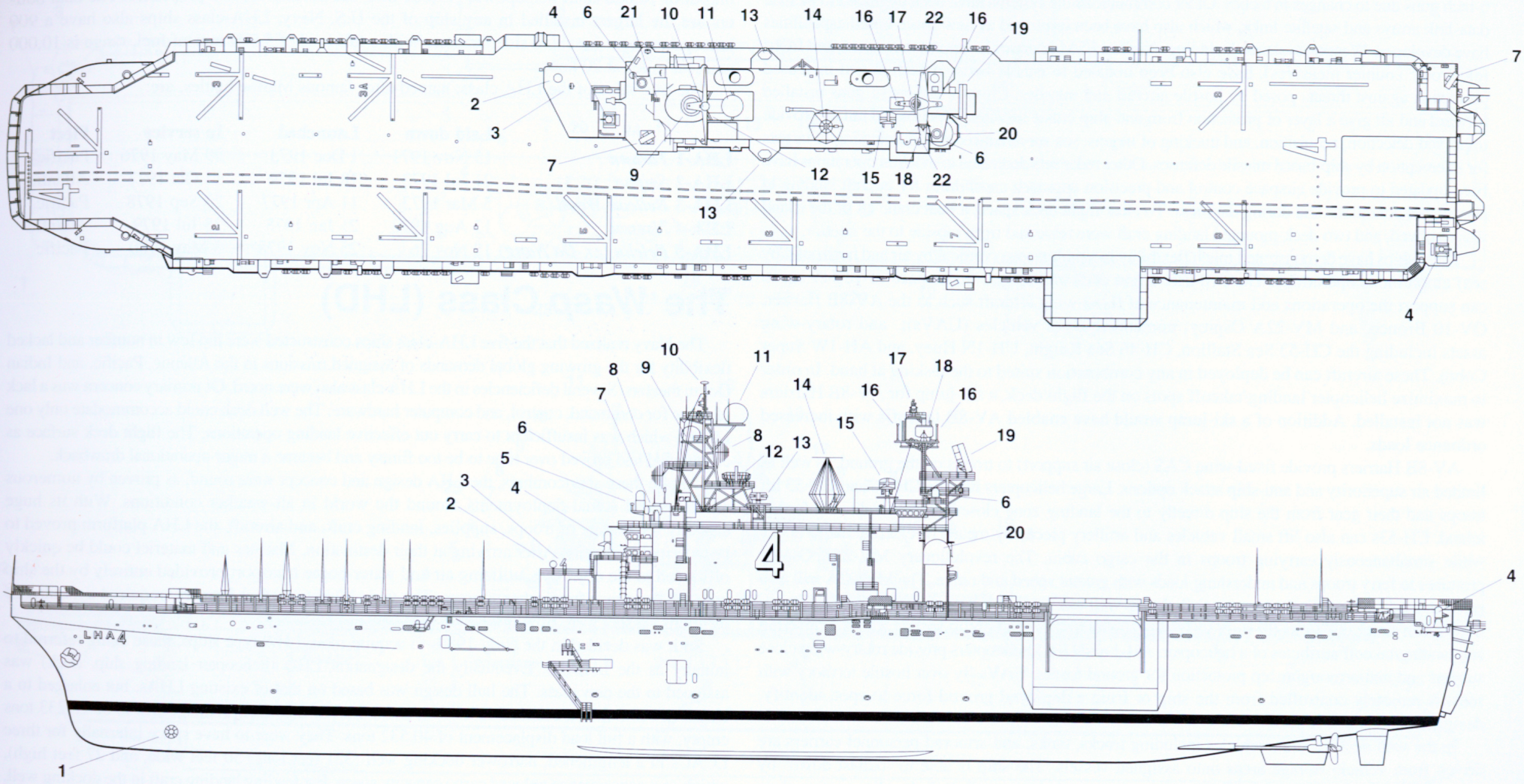
Modern amphibious assault ships currently in use by the United States Navy and Marine Corps are the ultimate expression of the concept of amphibious warfare, a concept that has been proposed, tested, and refined under combat conditions. Of all the types in use today, the LHA and LHD classes are the largest and most capable.

The *Tarawa* Class (LHA)

The LHA (helicopter landing ship, assault), or *Tarawa* class, was designed in the late 1960s to supplement and ultimately replace the LPH (landing ship, helicopter) and LPD (landing ship, dock) classes that were limited in the amount of vehicles, stores, and helicopters they could carry. As amphibious landing techniques evolved following World War II, the helicopter assault of contested areas has become the primary method of moving troops from ships offshore to landing zones onshore. The Marines therefore required larger vessels capable of carrying and maintaining a substantial number of rotary-winged assets and equipment. LHA construction was to have totaled nine, but four were cancelled, with only five built to lift one and one-third Marine Expeditionary Units (MEUs) and all of their equipment. LHA hulls are 833.7 feet long with a beam of 106 feet (extreme beam width with side elevator horizontal is 132 feet) and a draft of 25.9 feet. Folding elevators allow passage through the Panama Canal. Tonnage ranges from 27,195 tons (light) to 39,967 tons (full load). These ships can operate alone, as part of a task force, or as a flagship during amphibious operations. When first deployed, all ships had three 5-inch (127 mm) guns, two forward and one aft. Extensive self-defense capabilities, command and communications spaces, a hospital facility of 352 beds with four operating rooms, and a mortuary were designed into the ships. All interior spaces are air-conditioned. Each can carry enough food, water, fuel, and facilities to sustain five thousand people aboard for up to six months, but in an emergency, up to eight thousand people can be handled for a shorter period. Vehicle storage space amounts to 24,416 square feet. When vehicles are driven into the ship and secured or positioned for unloading, forced air ventilation systems prevent the buildup of engine exhaust fumes. Palletized cargo spaces total 107,000 square feet.

Approximately 1,200 tons of JP-5 aviation fuel and fifty tons of fuel for vehicles can be carried. An aft well deck or docking well 250 feet in length, 76 feet wide, and 26 feet high is able to accommodate four LCUs (landing craft, utility) or seven LCMs (landing craft, mechanized) or one LCAC (landing craft, air cushioned). An overhead monorail system allows vertical loading and unloading of vessels in the docking well. Two elevators (one of twenty-ton capacity on the port side, 50 by 34 feet, folding; the second, of forty-ton capacity, aft, 59.75 by 34.75 feet) deliver aircraft from the hangar deck to the flight deck. An LHA is able to offload the assault element of an Marine Amphibious Unit (MAU) in just less than three hours, for a total of 511 tons of cargo being transferred off the ship. The LHA profile is similar to that of an aircraft carrier, the large (▸▸ 6)

Tarawa-class Helicopter Landing Ship, Assault — USS *Nassau* (LHA-4), 2000



Key:

1. Bow thruster
2. Sea Tel SATCOM
3. WSC-3/OE-82 UHF SATCOM
4. Mk 15 Close-In Weapon System (CIWS)
5. Furuno navigation radar
6. USC-38 EHF SATCOM
7. Mk 31 Rolling Airframe Missile (RAM) 21-cell launcher
8. Direction finding (DF) array
9. SPQ-9 fire control radar
10. URN-25 TACAN
11. WSC-6 SHF SATCOM
12. SPS-40 air search radar
13. SLQ-32 ECM array
14. Broadband discage antenna
15. SMQ-11 meteorological SATCOM
16. VHF antenna
17. Mk 23 Target Acquisition System radar
18. SPN-43 Carrier Controlled Approach radar
19. SPS-48 3-D early warning radar
20. SPN-35 aircraft marshalling radar
21. SPS-64 navigation radar
22. SAT-2 infrared transmitter

island being located along the starboard side of the flight deck. The island bristles with antennas, radars, radomes, defensive guns, and missile systems. The uppermost eighteen feet of the mainmast folds down for passing under bridges.

Modifications to these ships since their introduction to service have included the removal of the 5-inch guns due to changes in tactics. Older communications systems have been upgraded to include data-link arrays and satellite links, which also have been improved as new space-based capabilities have developed. Weapon systems, including missiles, ESM (electronic support measures), and ECM (electronic counter measures), have also been updated to enable better detection and increased protection against threats posed by hostile aircraft and missiles. Close-in defensive guns installed forward and aft give a layer of protection from anti-ship cruise missiles. Modernized radars provide improved detection, acquisition, and tracking of targets; sea surveillance; and illumination of targets for interception by ship-based missile defenses. Other radar sets dedicated to aviation operations have been updated to provide airspace control and precision approach capabilities for aircraft landing in all-weather conditions and during darkness. To clear flight deck space, a boat crane aft of the island was removed, and two deck-mounted landing craft were relocated from topside to the interior.

These ships have demonstrated much flexibility in simultaneous (vertical/by air and horizontal/by sea) amphibious operations. The two-acre flight deck and hangar deck space of 18,519 sq. ft. can support the operations and maintenance of fixed-wing aircraft such as the AV-8B Harrier, OV-10 Bronco, and MV-22A Osprey; unmanned aerial vehicles (UAVs); and rotary-wing assets including the CH-53 Sea Stallion, CH-46 Sea Knight, UH-1N Huey, and AH-1W Super Cobra. These aircraft can be deployed in any combination suited to the tasking at hand. In order to maximize helicopter landing/takeoff spots on the flight deck, a ski-jump for AV-8B Harriers was not installed. Addition of a ski-jump would have enabled AV-8B takeoffs with increased ordnance loads.

AV-8B Harriers provide fixed-wing CAS (close air support) to troops on the ground, as well as limited air superiority and anti-ship attack options. Large helicopters like the CH-46 and CH-53 lift troops and their gear from the ship directly to the landing zone close to the shoreline or further inland. CH-53s can also lift small vehicles and artillery pieces by means of external cargo hooks while simultaneously carrying troops in the cargo cabin. The revolutionary MV-22A Osprey promises to ferry troops and underslung loads with greater speed and range. The MV-22A will also perform medevac (medical evacuation) flights as well as CSAR (combat search and rescue) operations much faster due to its tilt-rotor technology, which offers turboprop speeds with the hovering and landing/takeoff attributes of a helicopter. AH-1 and UH-1 helicopters provide rotary-wing close support and anti-armor/gunship protection for ground forces. UAVs fly over hostile territory with sensors remotely controlled from the ship or from a deployed ground force to spot, identify, designate, and attack targets.

In the well deck section, vehicles including trucks, tanks, and armored personnel carriers are driven from vehicle storage areas onto assigned vessels. The ship is able to 'ballast down' by flooding aft sections of the hull, allowing water to enter the open well deck. Landing craft such as LCUs or LCMs float free of the well deck surface and depart by way of the opened sectional gate into open waters. The amphibious assault vehicle (AAV) can be driven from its storage space into the docking well, load up, and proceed directly into the water and to the shore, self-propelled by two aft-mounted water jets. The LCAC backs out of the ship and heads directly for the landing objective. An LCAC can deposit its load of tanks, infantry fighting vehicles, cargo, or personnel on the beach or move further inland to unload. On the return trip, landing craft enter the well deck to take on a new load of cargo to be delivered ashore. If operations have concluded, the stern gate closes, the water is pumped out and the well deck is once again high and dry.

An LHA crew complement is eighty-six to ninety-four officers and 871 to 979 enlisted personnel to operate the ship. Marine complement includes 172 officers and 1,731 troops. The ships are able to attain a maximum speed of 23.5 knots by way of two boilers (operating at 600 psi at 900 degrees Fahrenheit) providing steam to geared turbines generating a sustained output of 70,000 shaft horsepower (77,000 SHP maximum) via two propellers. The dual boilers are the largest installed in any ship of the U.S. Navy. LHA-class ships also have a 900 horsepower bow-mounted side thruster. With a full load of 5,900 tons of fuel, range is 10,000 nautical miles at 20 knots.

The five ships of the LHA class, named after famous Marine battles, are:

	Laid down	Launched	In service	Fleet
LHA-1 ***Tarawa***	15 Nov 1971	1 Dec 1973	29 May 1976	Pacific
LHA-2 ***Saipan***	21 Jul 1972	18 Jul 1974	15 Oct 1977	Atlantic
LHA-3 ***Belleau Wood***	5 Mar 1973	11 Apr 1977	23 Sep 1978	Pacific
LHA-4 ***Nassau***	13 Aug 1973	21 Jan 1978	28 Jul 1979	Atlantic
LHA-5 ***Peleliu*** (ex-***Da Nang***)	12 Nov 76	25 Nov 1978	3 May 1980	Pacific

The *Wasp* Class (LHD)

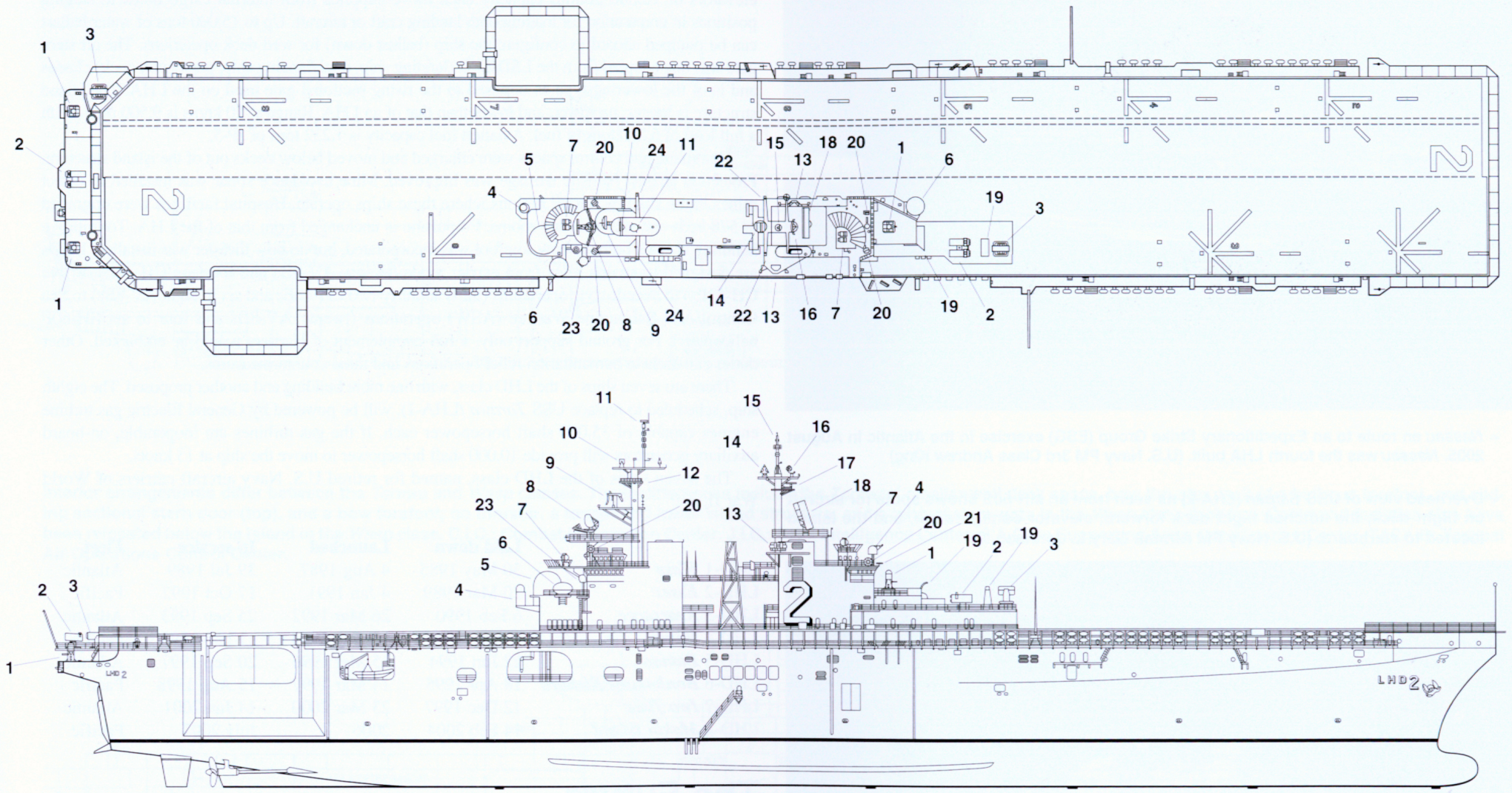
The Navy realized that the five LHA-class ships constructed were too few in number and lacked flexibility for the growing global demands of assigned missions in the Atlantic, Pacific, and Indian Ocean theaters. Several deficiencies in the LHA class also were noted. Of primary concern was a lack of space for command, control, and computer hardware. The well deck could accommodate only one LCAC, which was insufficient to carry out effective landing operations. The flight deck surface as constructed had proved over time to be too flimsy and became a major operational drawback.

Despite these shortcomings, the LHA design and concept were sound, as proven by numerous exercises and actual deployments around the world in all-weather conditions. With its huge capacity for storage of troops, supplies, landing craft, and aircraft, the LHA platform proved to be extremely versatile. After arriving at their destination, Marines and materiel could be quickly offloaded to the objective, utilizing air and water-borne transport provided entirely by the ship without assistance from other sources. The varied functions that formerly required a number of different vessels were now integrated into one.

So it was decided in the early 1980s to acquire more LHA-type ships, these being referred to initially as the LHD(X). Eventually the designation LHD (helicopter landing ship, dock) was assigned to the new class. The hull design was based on that of existing LHAs, but enlarged to a length of 843.9 feet, a beam of 139.9 feet, and a draft of 26.6 feet. Tonnage was to be 28,233 tons empty, with a full load displacement of 40,532 tons. They were to have space internally for three LCACs in a lengthened, narrower docking well (321 feet long, 50 feet wide, and 27 feet high), which as a consequence reduced cargo capacity space. For loading landing craft in the docking well, the new design retained the overhead monorail system proven in the LHA class. This consists of six tracks of 2,900 feet total length and a capacity of 6,000 pounds. Five 32-foot monorails move at 6.8 mph. No 5-inch guns were mounted, so the flight deck was squared off at the bow, unlike the notched forward flight deck on LHAs. This allows up to nine CH-53E helicopters to be positioned on the flight deck at one time with rotors turning. Once again a proposed 'ski-jump' for enhanced Harrier operations was abandoned, denying rolling takeoffs with an increased ordnance load. The improved flight deck was constructed of stronger HY100 steel. The hangar deck below is 84.9 feet wide and 20.9 feet high.

(▸▸ 8)

Wasp-class Helicopter Landing Ship, Dock — USS *Essex* (LHD-2), 1992

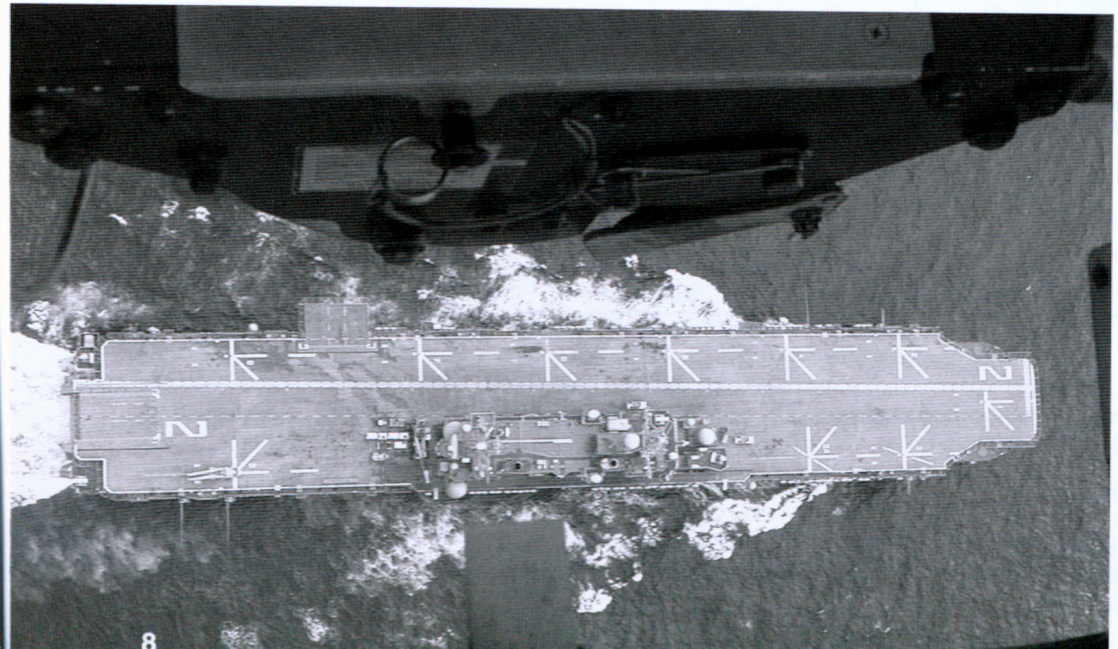


Key:

1. Mk 15 Close-In Weapon System (CIWS)
2. Mk 29 RIM-7 NATO Sea Sparrow eight-round launcher
3. Mk 49 21-round RAM launcher
4. USC-38 EHF SATCOM
5. SPN-35 aircraft marshalling radar
6. WSC-6 SHF SATCOM
7. Mk 95 Sea Sparrow guidance radar
8. SPS-49 air search radar
9. SPN-43 Carrier Controlled Approach radar
10. Mk 23 Target Acquisition System radar
11. URN-25 TACAN
12. UPX-29/OE-120 IFF array
13. SLQ-32(V)3 ECM array
14. SMQ-11 meteorological SATCOM
15. SRS-1 direction finding (DF) array
16. SPS-67 navigation radar
17. SPS-64 navigation radar
18. SPS-48 3-D early warning radar
19. Blast shields
20. WSC-3/OE-82 UHF SATCOM
21. Furuno navigation radar
22. SAT-2 infrared transmitter
23. Marisat SATCOM
24. UHF/VHF antenna

▲ *Nassau* en route to an Expeditionary Strike Group (ESG) exercise in the Atlantic in August 2005. *Nassau* was the fourth LHA built. (U.S. Navy PM 3rd Class Andrew King)

▼ Overhead view of USS *Saipan* (LHA-2) as seen from an MH-60S shows spots for aircraft on flight deck, the notched flight deck forward, elevator configuration, and the island located to starboard. (U.S. Navy PM Airman Gary L. Johnson III)



In the interest of gaining maximum use of flight deck space, the aft elevator was relocated from the stern to the starboard side. Either elevator (each 49.8 feet long x 44.9 feet wide) is capable of lifting aircraft weighing up to 68,000 pounds from the hangar deck to the flight deck. Six internal cargo elevators of 10,800 pounds capacity each move supplies from internal cargo holds to staging positions in preparation for loading onto landing craft or aircraft. Up to 15,000 tons of water ballast can be pumped aboard to configure the ship (ballast down) for well deck operations. The aft stern gate was one adopted from the LSD/LPD (landing ship, dock/landing ship, personnel, dock) classes and is of the lowering type as opposed to the rising sectional gate used on the LHA. The island structure is longer, narrower, and lower than that of an LHA. Range at 20 knots is 9,500 miles with a full load of 6,200 tons of fuel. Aviation fuel capacity is 1,232 tons of JP-5.

Command and control spaces were enlarged and moved below decks out of the island structure. Protection against ballistic damage was improved. Mine avoidance sonar was installed to detect mines in the shallow littoral regions where these ships operate. Hospital facilities were upgraded to 578 beds and six operating rooms. Propulsion is unchanged from that of the LHA. To improve handling at sea a bulbous bow forefoot was incorporated, but no bow thruster was installed. LHDs are designed to switch roles from carrier mode (twenty AV-8Bs and fourteen CH-46Es or five CH-53Es) to assault-style operations (thirty to thirty-two CH-46Es and six to eight AV-8Bs) to Sea Control/Anti-Submarine Warfare (ASW) operations (twenty AV-8Bs and four to six SH-60F helicopters). For ground support only, a full complement of Harriers would be embarked. Other duties can include humanitarian relief operations and mine countermeasures.

There are seven ships of the LHD class, with one more building and another proposed. The eighth ship, scheduled to replace USS *Tarawa (*LHA-1), will be powered by General Electric gas turbine engines capable of 35,000 shaft horsepower each. If the gas turbines are inoperable, on-board auxiliary generators will provide 10,000 shaft horsepower to move the ship at 13 knots.

The seven ships of the LHD class, named for retired U.S. Navy aircraft carriers of World War II, are:

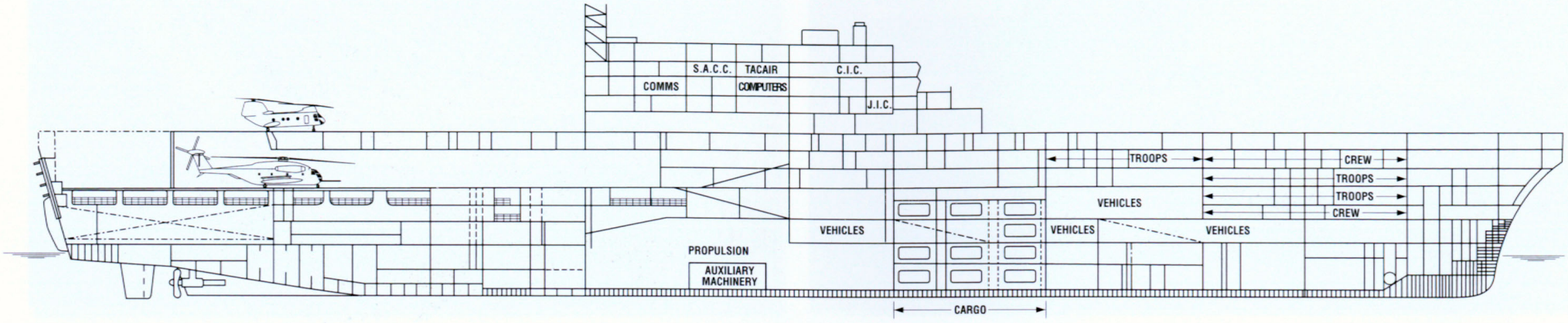
	Laid down	Launched	In service	Fleet
LHD-1 ***Wasp***	30 May 1985	4 Aug 1987	29 Jul 1989	Atlantic
LHD-2 ***Essex***	20 Mar 1989	4 Jan 1991	17 Oct 1992	Pacific
LHD-3 ***Kearsarge***	6 Feb 1990	26 Mar 1992	25 Sep 1993	Atlantic
LHD-4 ***Boxer***	8 Apr 1991	13 Aug 1993	11 Feb 1995	Pacific
LHD-5 ***Bataan***	22 Jun 1994	15 Mar 1996	20 Sep 1997	Atlantic
LHD-6 ***Bonhomme Richard***	18 Apr 1995	14 Mar 1997	15 Aug 1998	Pacific
LHD-7 ***Iwo Jima***	12 Dec 1997	23 Mar 2000	14 Jun 2001	Atlantic
LHD-8 ***Makin Island***	14 Feb 2004	2006	July 2007	Pacific

The Future

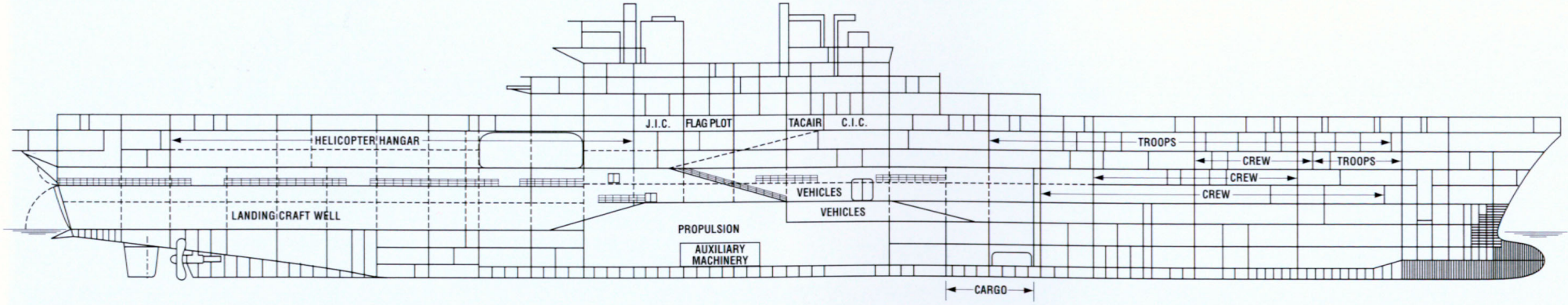
LHA replacement ships, or LHA(R)s, are programmed as the LHA-1 class is withdrawn from service. These new LHAs will carry an air wing consisting of ten F-35 Joint Strike Fighters, twelve MV-22A Osprey tilt-rotor aircraft, eight UH-1Y utility and AH-1Z attack helicopters, and four heavy-lift CH-53E helicopters, but have no well deck to support amphibious vehicles. The first of these is scheduled to be delivered in 2013. But with the latest announcement by the Pentagon that acquisition of new amphibious assault vessels is to be reduced, the total number to be acquired is unknown. In today's climate, the advanced planning and design of any new warship construction are subject as much to budgetary constraints as they are to world events.

(▸▸ 12)

Interior Arrangements



Interior arrangements differ between the *Tarawa* and *Wasp* classes. These differences include the *Tarawas*' smaller well deck space, bow thruster, lack of a bulbous forefoot, and sliding sectional stern door (top), and a bow forefoot, no thruster, a longer and lower island structure, and a hinged stern gate in the *Wasp* class (bottom). Command facilities also have been relocated below the island in the *Wasp* class. C.I.C.: Combat Information Center. J.I.C.: Joint Intelligence Center. S.A.C.C.: Supporting Arms Coordination Center. TACAIR: Tactical Air Operations Control Center.



▲ *Tarawa* receives fuel from USS *Yukon* (T-AO 202) while underway during Operation IRAQI FREEDOM. (U.S. Navy PM 2nd Class Larry S. Carlson)

▲ CH-46 and CH-53 helicopters prepare to launch from flight deck of *Saipan* during an ESG training exercise in the Atlantic in April 2004. Notched flight decks are a recognition feature of the LHA class. A 5-inch gun formerly occupied the area where the round cover plate is seen. (U.S. Navy PM 1st Class Courtney Torgrude)

▶ *Belleau Wood* is ballasted down with stern door raised to allow an LCU to enter well deck. The CH-46 is providing aerial transport while moving the 11th MEU ashore in Kuwait. (U.S. Navy PM 1st Class Alan D. Monyelle)

▼ *Tarawa* patrols the Persian Gulf as an LCU and CH-53 depart for shore facilities in Kuwait. (U.S. Navy PM 3rd Class Taylor Goode)

▲ An LCU returns to USS *Belleau Wood* after transferring Marines of the 11th MEU ashore to Kuwait in July 2004. The LHA is ballasted down with stern door open. (U.S. Navy PM 1st Class Bart Bauer)

▲ Off Vieques, Puerto Rico, LCAC 37 enters the well deck of *Kearsarge* during Joint Task Force Exercise 99-1 in February 1999. (U.S. Navy CWO2 Seth Rossman)

▼ An AV-8B launches from *Kearsarge*, underway during a scheduled cruise in the Mediterranean. Like their aircraft carrier 'big sisters,' LHAs and LHDs sail into the wind during air operations. (U.S. Navy PM Airman Sarah E. Ard)

Well Deck Operations

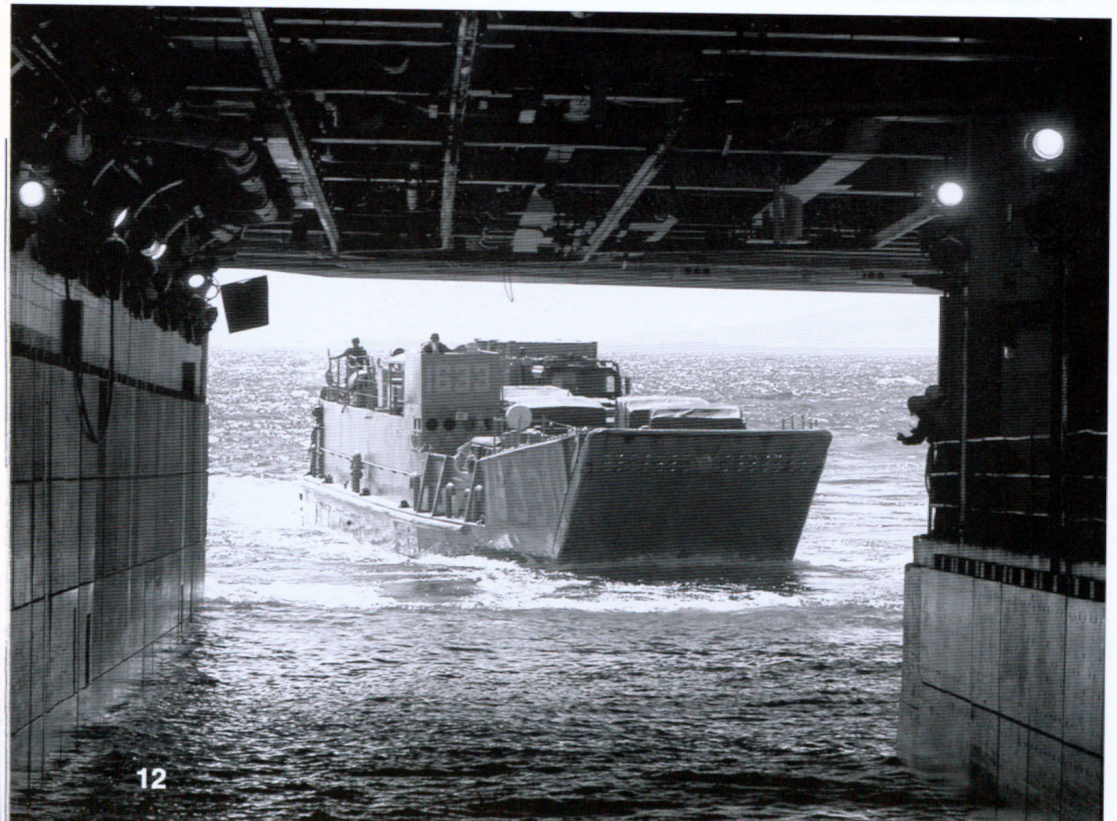
Were it not for the well deck designed into these ships, they would simply be unable to project personnel and equipment to objectives in a timely manner. The ability to load and unload large, bulky items such as tanks, assault vehicles, towed artillery, and ammunition quickly is at the heart of the mission for which these ships were designed.

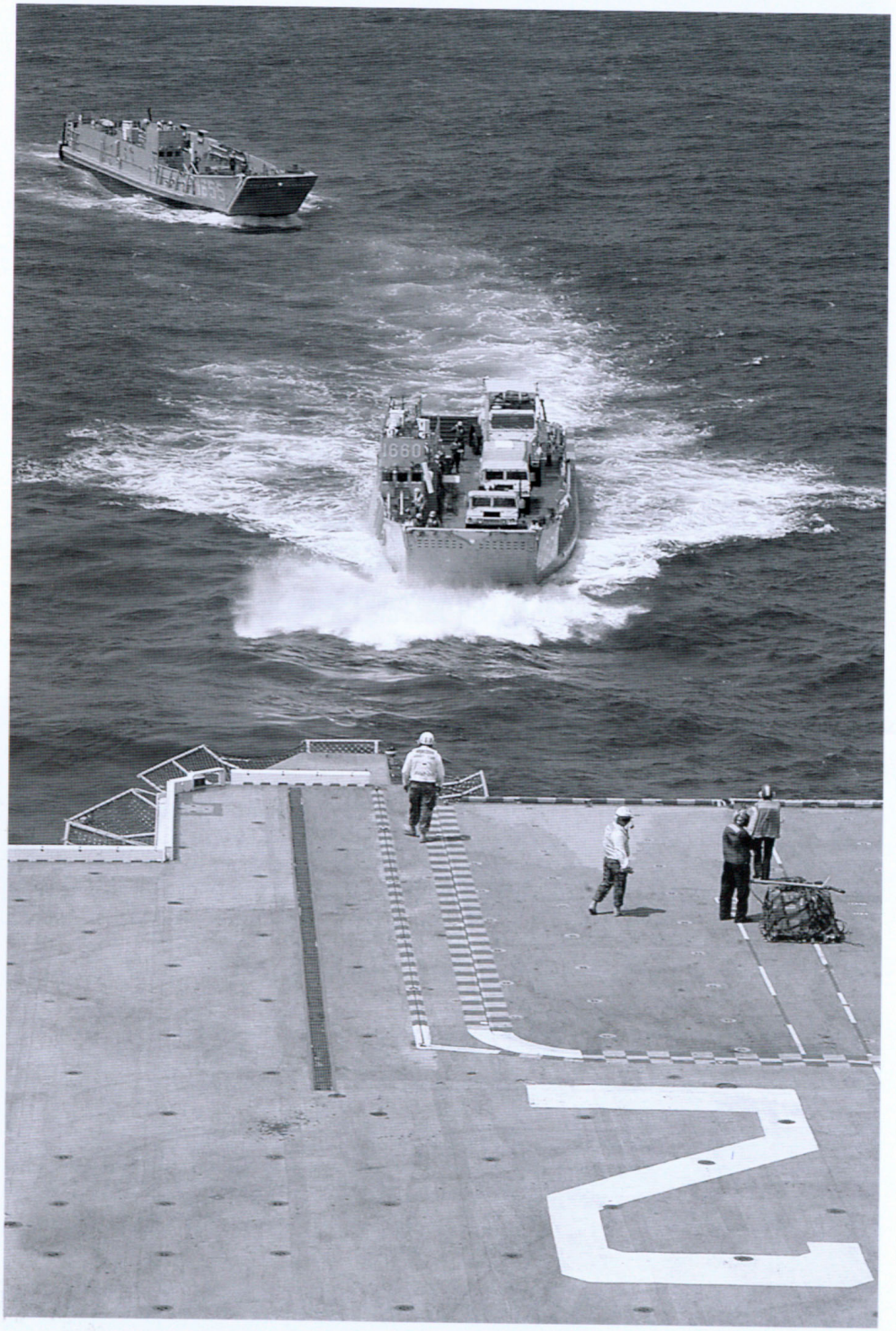
With LCUs (Landing Craft, Utility) and LCACs (Landing Craft, Air Cushion), the job of moving such outsized hardware ashore is greatly simplified. While the ship is en route to an objective, LCAC and LCU landing craft are loaded while they rest in the well deck. Pre-packaged stores are moved by the overhead monorail system, which positions cargo above the landing craft then lowers it into place, where it is lashed down for the eventual trip from the flooded well deck to the shore, or if being transported via LCAC, further inland.

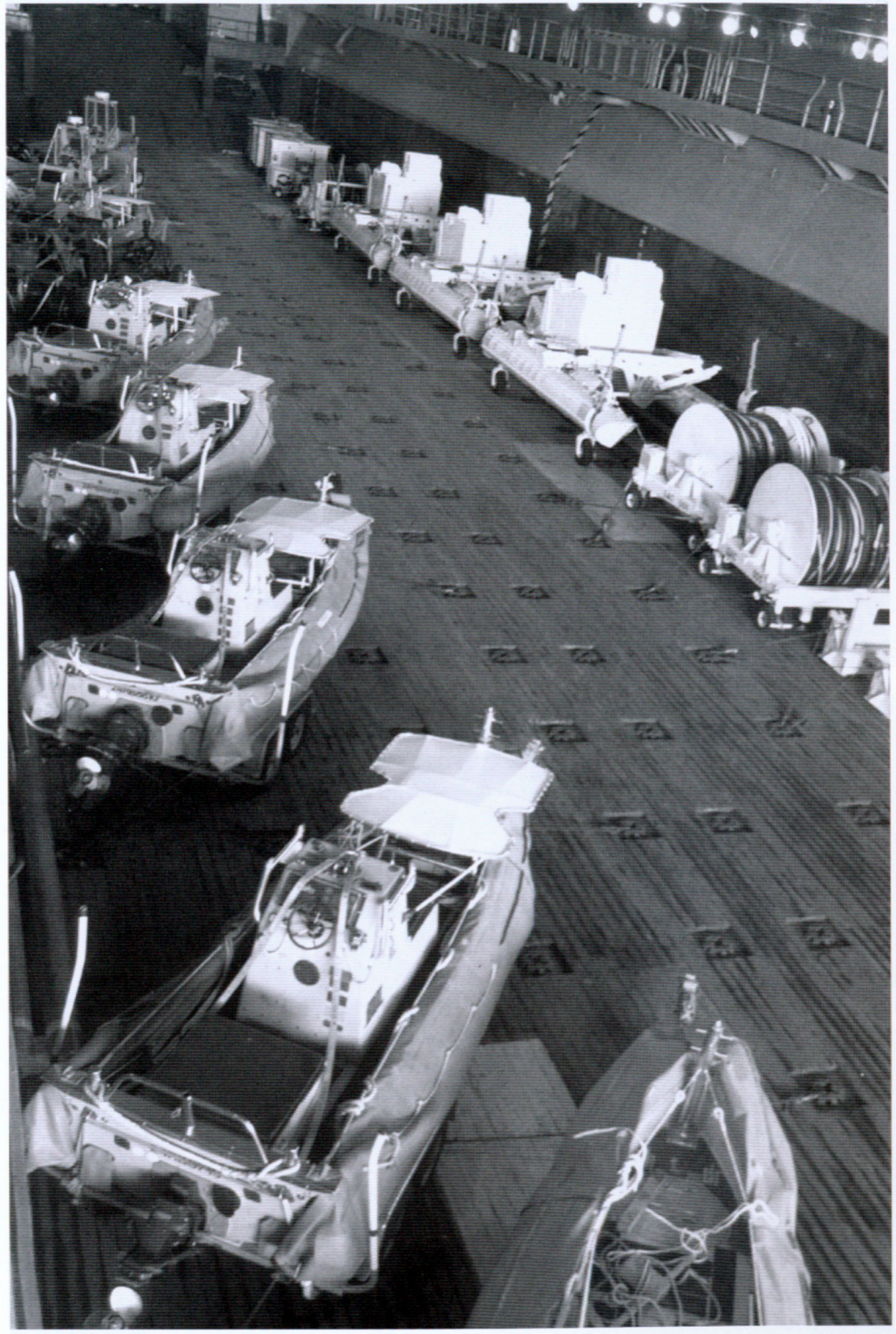
Also able to depart from the well deck is the AAV7A1 or Amphibious Assault Vehicle (AAV). This marine version of an Armored Personnel Carrier is propelled through the water with its tracks and a set of ducted water jets driven by the engine. Upon exiting the well deck, it heads for the shore. AAV variants include communications and mine clearance vehicles. A replacement for this vehicle, the Advanced Amphibious Assault Vehicle (AAAV), will move faster through the water and have heavier armament. (▸▸ 18)

▸ **LCUs (Landing Craft, Utility) 1655 and 1660 of ACU-4 approach open well deck of *Saipan* after completing an amphibious landing exercise in July 2004. (U.S. Navy)**

▾ **LCU 1633 as seen from inside the flooded well deck of *Tarawa* during exercise RIMPAC 2004. (U.S. Navy)**



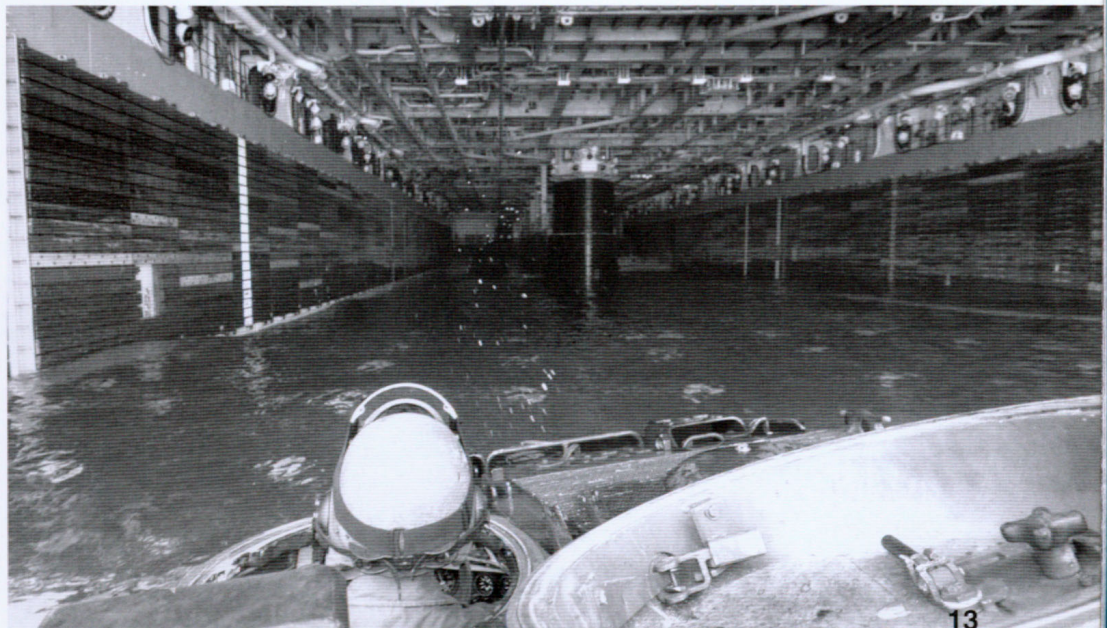


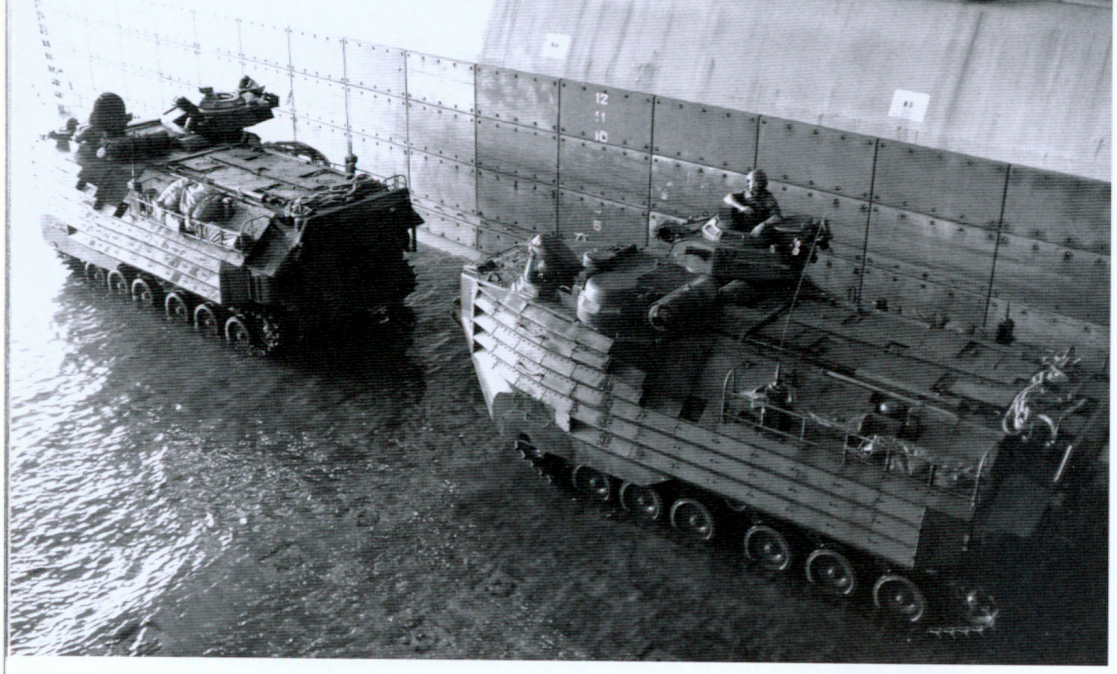


▲ LCU-1635 with a load of vehicles inside well deck of *Tarawa* during the annual exercise of Pacific rim navies (RIMPAC 04). (U.S. Navy PM 2nd Class Bradley J. Sapp)

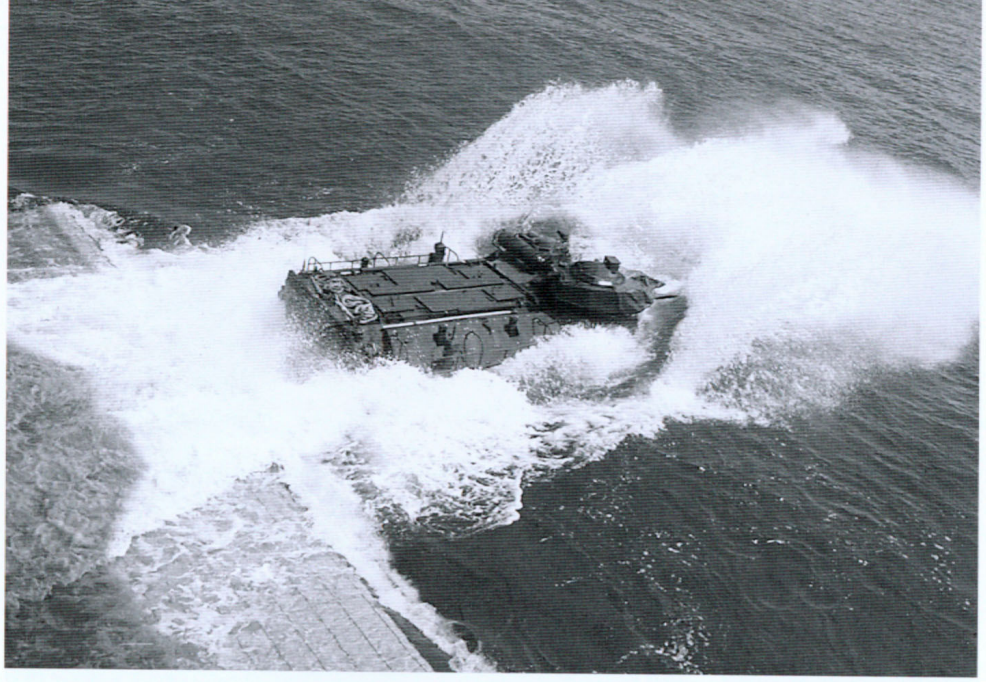
◀ En route to a MINEX exercise, the well deck of *Kearsarge* is configured for mine clearance operations with Rigid Hull Inflatable Boats (RHIBs), Mk 105 sleds, and cable reels, all secured for transport. Numerous tie-downs can be seen on deck. (U.S. Navy PM 3rd Class Jose Ponce)

▼ A flooded well deck is seen here as an AAV enters *Peleliu*. An LHA can carry one LCAC, as opposed to three in the LHD class ships. An LHA's well deck is 250 feet long and 76 feet wide, with a height of 26 feet. (U.S. Navy PM 2nd Class Prince A. Hughes III)





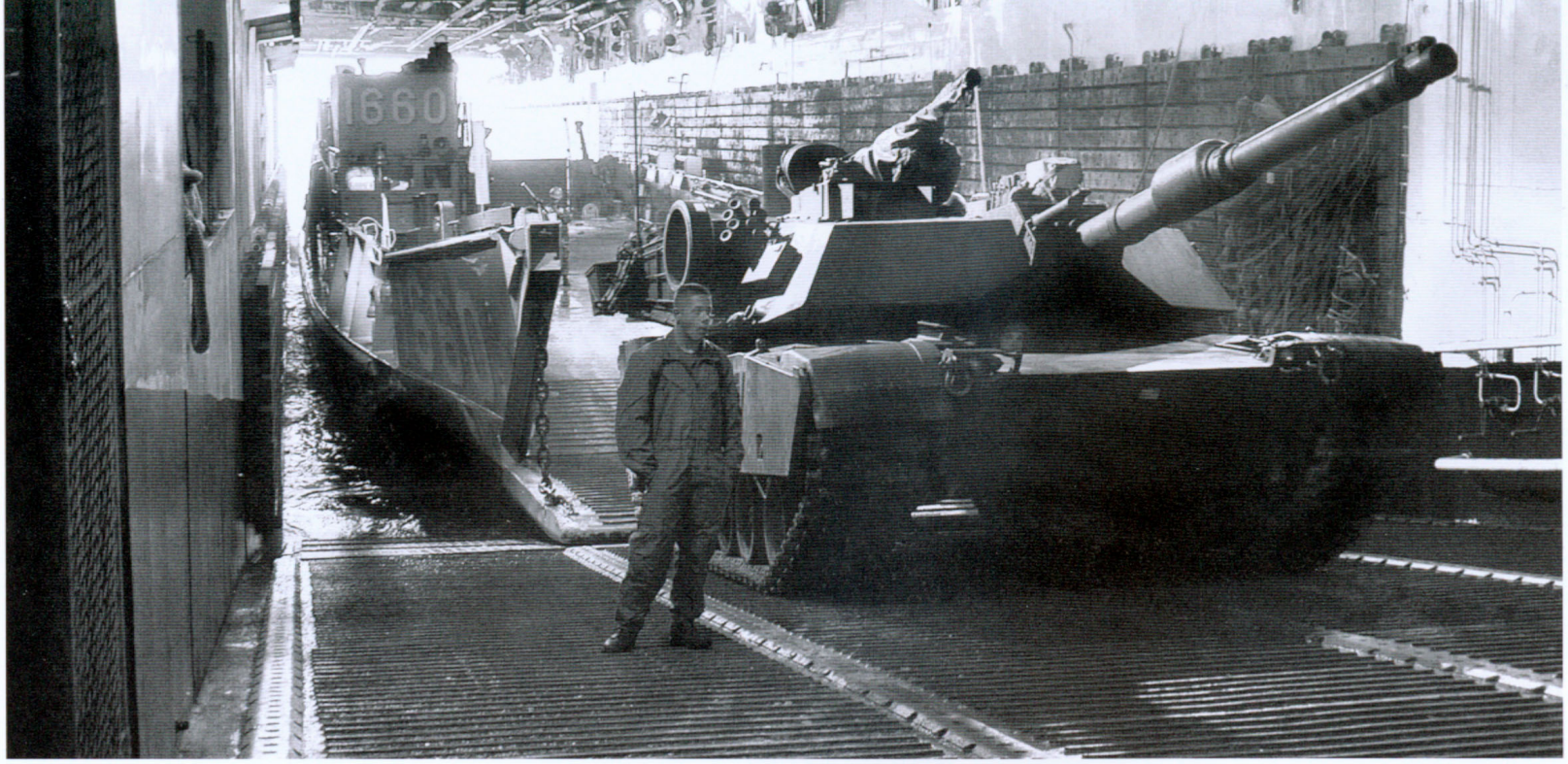
▲ A pair of AAVs await to depart USS *Essex* while in the Philippine Sea during ARGEX, the Amphibious Ready Group Exercise. Well deck is partially flooded. (U.S. Navy PM 3rd Class Nicholas Messina)



▲ With a huge splash, an AAV of the 3rd Amphibious Assault Battalion, Camp Pendleton, California, exits USS *Bonhomme Richard* in the Pacific Ocean, April 2004. (U.S. Navy PM 3rd Class Emmanuel Rios)

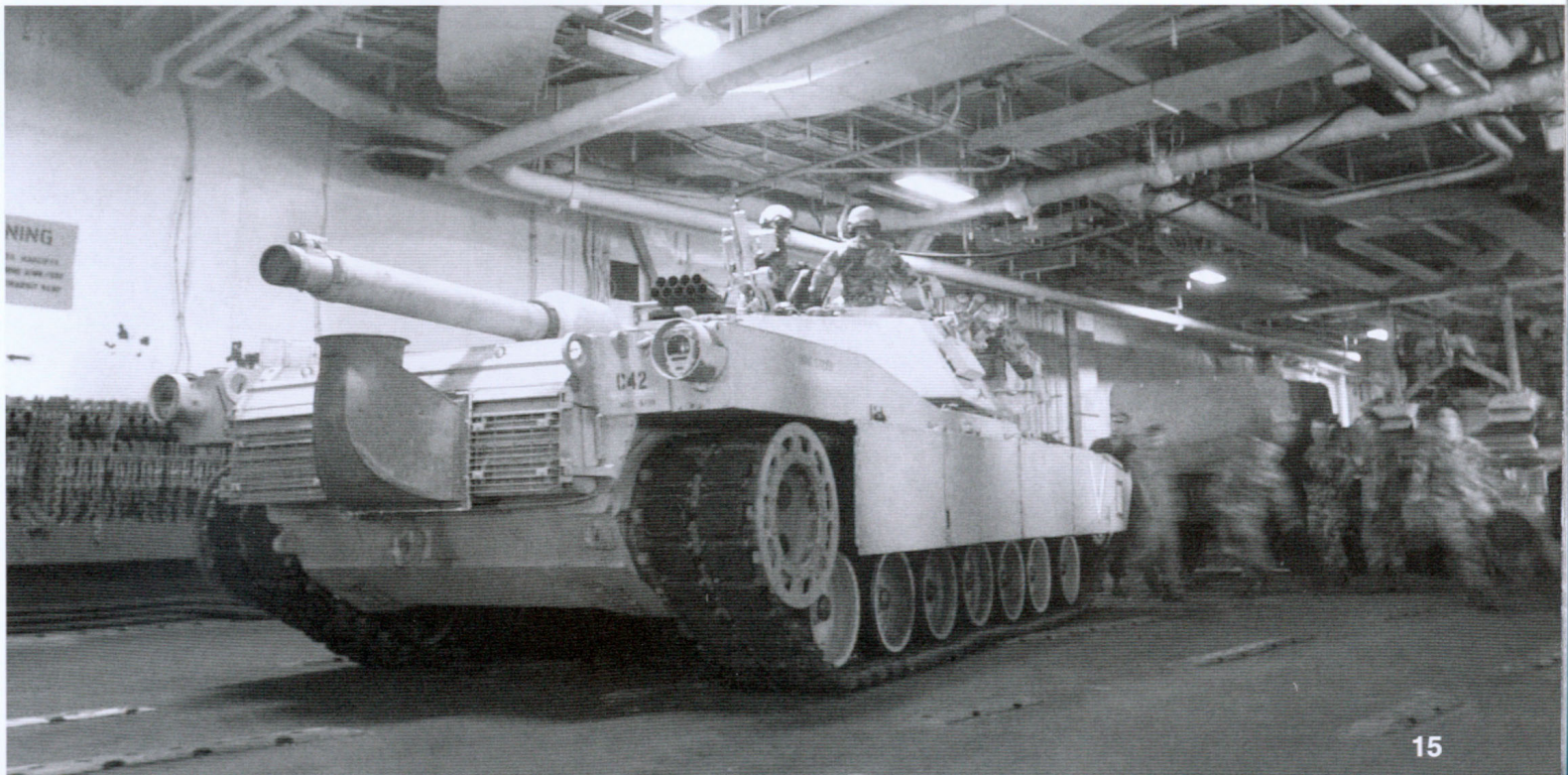
▼ AAVs recover aboard *Bonhomme Richard* during operations in the Pacific Ocean. Ship can take on up to 15,000 tons of water to flood deck. (U.S. Navy PM 2nd Class Jennifer Swader)

▼ In this overhead view, an AAV departs *Bonhomme Richard* in the Pacific Ocean in April 2004. (U.S. Navy PM 3rd Class Jennifer Rivers)



An M1-A1 Abrams main battle tank of the 24th MEU is driven off LCU 1660 into the well deck of *Saipan*. Overheac monorail tracks in well deck, used for handling cargo, can be seen overhead. (U.S. Navy PM 2nd Class Robert M. Schalk)

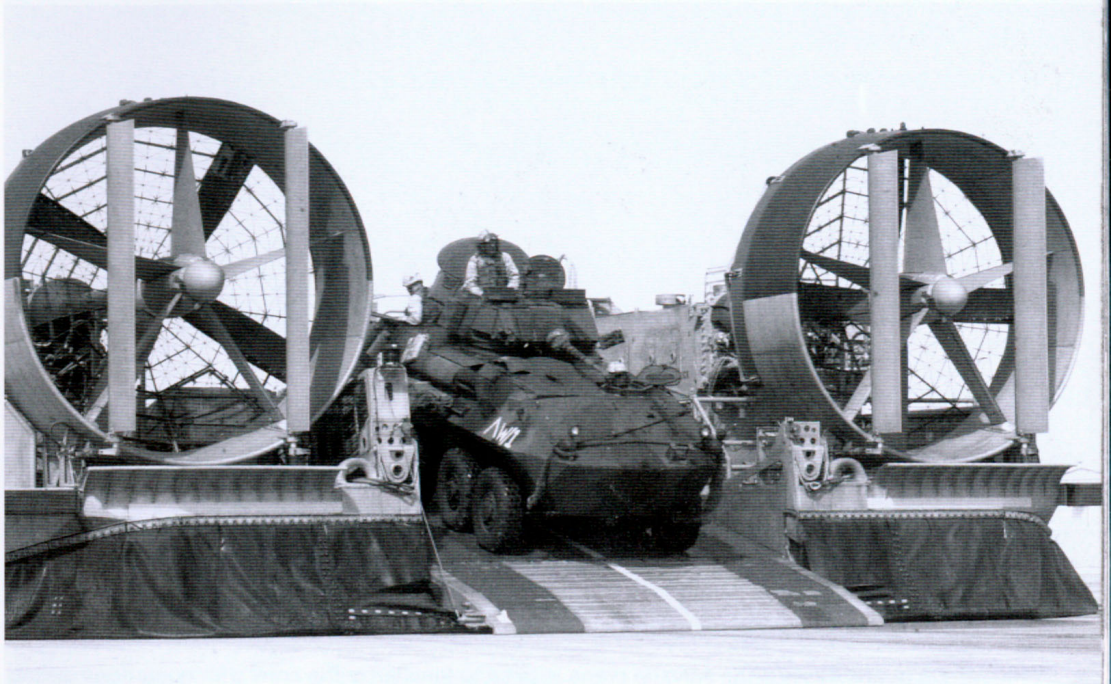
An M1 tank moves inside the vehicle deck of *Tarawa* in March 2001 during exercise KERNEL BLITZ. Below the tank's gun barrel is the exhaust deflector that propels engine gases upward into the ship's vehicle fume extraction system, used when vehicles are driven from inside storage areas to the well deck. (U.S. Navy PM 3rd Class Jennifer A. Smith)



▲ An Amphibious Assault Vehicle (AAV) about to enter the well deck of *Saipan* as seen in this overhead view. AAVs have the ability to move through the water by means of aft-mounted water jets. (U.S. Navy PM 2nd Class Steven J. Weber)

▲ LCAC 69 at sea in January 2003 with a load of combat vehicles. LCAC can turn within its own length and maintain sustained speeds of up to 30 knots in Sea State 3 conditions. Forward and aft ramps enhance loading operations. (U.S. Navy PM 3rd Class Angel Roman-Otero)

◀ LCAC 47 prepares to offload LAVs while LCAC 58 maneuvers in the background during a RIMPAC exercise on the beaches of Barking Sands, Hawaii, in July 2002. Ramps can only be lowered once skirt is deflated. (U.S. Navy Lt. Cmdr. Jane Campbell)



▲ At Camp Patriot, Kuwait, a Light Armored Vehicle (LAV) drives off an LCAC down the aft ramp. Ducted propellers are 11¾ feet in diameter. Not visible are the lift fans that inflate the skirt. (U.S. Navy PM 1st Class Arlo K. Abrahamson)

◀ At Bellows AFB in July 2004, LCAC 64 sits on the beach with skirt deflated alongside LCAC 79 during a RIMPAC exercise. An LCAC can carry sixty tons of cargo 200 nautical miles at speeds up to forty knots and clear obstacles up to four feet high. (U.S. Navy PM 1st Class David A. Levy)

▲ On board *Nassau*, the salvage crane is used to familiarize the crew with operations during an exercise. This equipment is very useful for heavy lifting and moving of disabled aircraft. (U.S. Navy PM 1st Class Anibal Rivera)

▼ Harrier pilot checks wing munitions and pylons on *Peleliu* (LHA-5). Rough finish is a fire resistant coating. Bombs are live with fuses installed. (U.S.M.C. Sgt. Joseph R. Chenelly)

Flight Deck Operations

LHA/LHD flight decks are designed to handle mass movements of AV-8B Harriers; AH-1W Cobra gunships; and UH-1, CH-46, CH-53/MH-53, and SH-60 series helicopters. Future operations will include the tiltrotor V-22 Osprey and the F-35 Joint Strike Fighter. Helicopters are used for Vertical Replenishment (VERTREP), the vertical loading and offloading of stores and ammunition via helicopters to and from other ships. While their rotors are turning, helicopters are also used to swiftly disembark troops off the flight deck, maximizing vertical mobility.

Training activities carried out on the flight deck include fast rope exercises from hovering helicopters, insertion/extraction drills, and Search And Rescue (SAR) scenarios. An array of radars scans the airspace around the ship for safe passage of aircraft, tracks and controls aircraft entering the airspace around the ship, and provides accurate landing guidance in fog or inclement weather conditions.

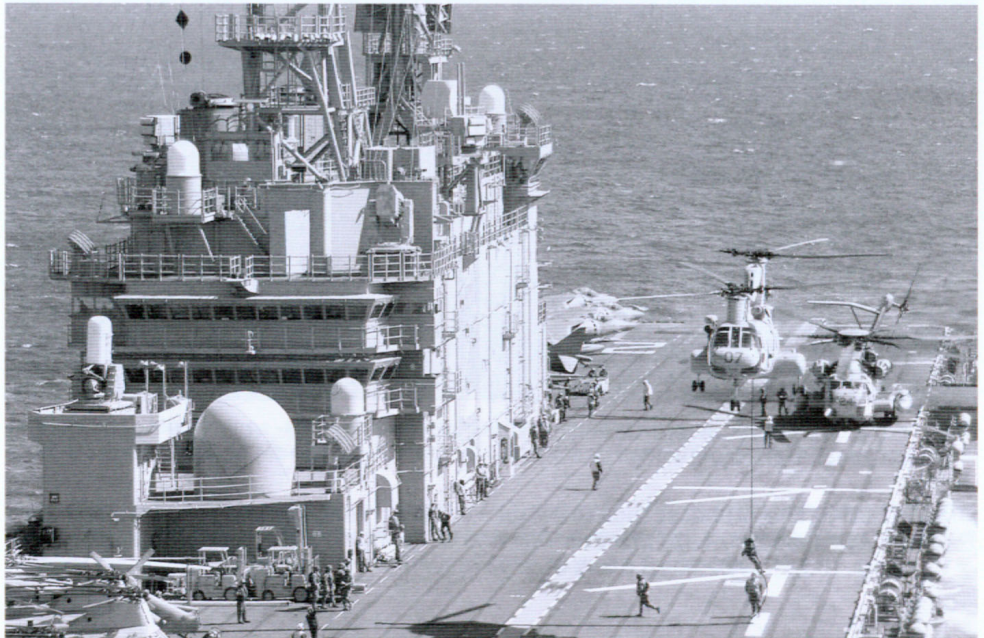
Located below the flight deck is the hangar space, where aircraft are serviced, inspected, and prepared for the next mission. After being checked thoroughly, aircraft are towed to one of the elevators where they are taken up vertically to the flight deck. (▸▸ 45)

▼ Marine Light Attack Squadron 269 (HMLA-269) ordnancemen move 4 AGM-114K Hellfire missiles on flight deck of *Saipan* during Operation Iraqi Freedom. Yellow bands on munitions indicate live warheads. (U.S. Navy PM 3rd Class Robert M. Schalk)

▲ An AV-8B+ Harrier is moved inside *Tarawa*'s hangar deck. Nose radome contains APG-65 radar. The device above the radome is an AAR-51 FLIR (Forward Looking InfraRed). (U.S. Navy Chief Journalist William Polson).

▶ Harriers of HMM-263 at rest aft of island aboard *Nassau*. Chaff/flare modules have been removed from the aircraft. (U.S. Navy PM 2nd Class Michael Sandberg)

▼ Marines of the 24th MEU practice fast rope operations from a hovering CH-46 onto the deck of *Saipan* (LHA-2) under way in the Atlantic Ocean in April 2004. (U.S. Navy PM 1st Class Courtney Torgrude)



▲ Primary Flight Control Station (Pri-Fly) is located at the aft end of the island. Lt. Cmdr. McDowell directs aircraft movements on board *Saipan* during Operation Iraqi Freedom. (U.S. Navy PM 3rd Class Robert M. Schalk)

▲ AV-8B of VMA-223 hovers during certification training over *Saipan*'s flight deck in March 2004. (U.S. Navy)

◀ An AV-8B of VMA-311 descends to a landing as seen from the bridge and watchful eye of the Commander of *Bonhomme Richard* in February 2003 during Operation Iraqi Freedom. (U.S. Navy PM 3rd Class Staci M. Bitzer)

▲ With its three engines, the CH-53E can lift heavy loads such as this forklift being hoisted from the deck of *Peleliu*. (U.S. Navy PM 2nd Class James K. McNeil)

▶ An MH-53E Sea Dragon of HM-15 'Blackhawks' warms up on *Saipan* in the Persian Gulf. The MH-53E has enlarged sponsons for extra fuel. Rear view mirrors are visible on struts below lower cockpit windows. (U.S. Navy PM 1st Class Courtney Torgrude)

▲ While a FLIR-equipped CH-53E lifts off the deck of *Saipan*, the crew chief and flight deck marshaller keep watch for any hazards. (U.S. Navy PM 3rd Class Robert M. Schalk)

▲ An MH-60S undergoes 'hot' refueling (with rotors turning) aboard USS *Iwo Jima* during Task Force Katrina operations as a fuel systems crewman looks on. (U.S. Navy PM 3rd Class Christian Knoell)

▼ Operating rotary-wing aircraft in close proximity to large ships is routinely practiced to maintain aircrew proficiency. Here a CH-53E of HMM-263, the 'Thunder Eagles,' hovers above the flight deck of *Saipan* in March 2004 off the coast of Virginia. (U.S. Navy PM 1st Class Courtney Torgrude)

▲ An AH-1W Supercobra is refueled in 'hot' mode. The 'Whisky' variant of the Cobra gunship is powered by two GE T-700 engines. This evening photo was taken on *Belleau Wood* in August 2001. (U.S. Navy PM 3rd Class Sean C. Ryan)

▲ VERTREP (vertical replenishment) operations onboard *Belleau Wood* (LHA-3) using a CH-46E Sea Knight tandem rotor helicopter. This aircraft has had a long career and will be replaced by the V-22 Osprey. (U.S. Navy)

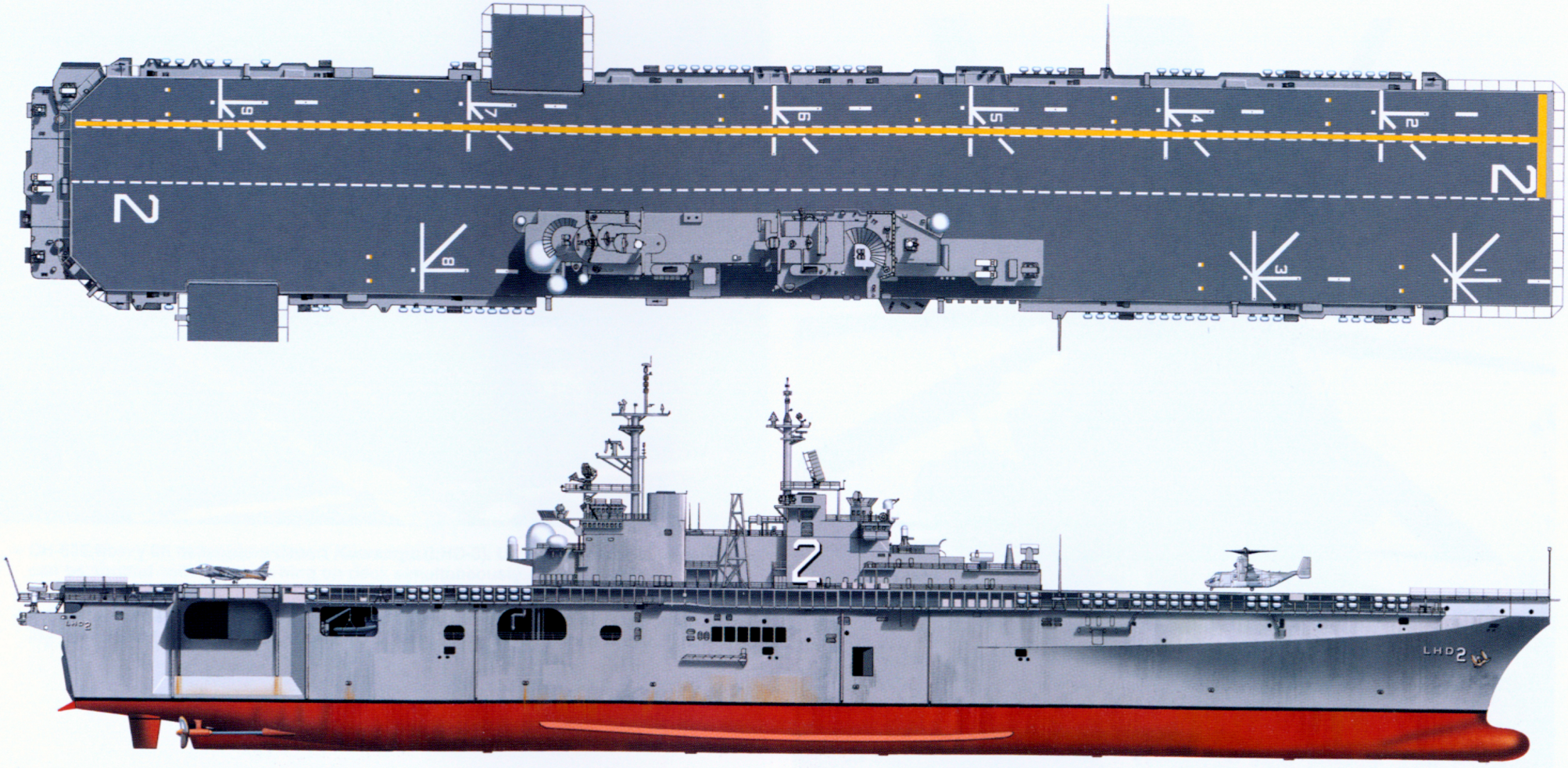
▲ Special Operations Capable (SOC) Marines of the 15th Marine Expeditionary Unit board a CH-46E (BuNo 156438/'YR-04') heading for Kuwait from *Tarawa* in the Persian Gulf. (U.S. Navy PM 2nd Class Ryan Child)

▼ With *Saipan* to port, an MH-60S Knighthawk conducts search and rescue (SAR) approaches. (U.S. Navy PM Airman Gary L. Johnson III)

▲ CH-53E heavy lift helicopters depart *Kearsarge* (LHD-3). Up to nine of these large aircraft can be spotted with rotors turning on deck simultaneously. (U.S. Navy)

▼ A CH-53E of HMH-466 'The Wolf Pack' flies to the starboard side of *Boxer* after delivering equipment to Camp Doha, Kuwait. (U.S. Navy PM 3rd Class Christopher Elmini)

▲ Onboard *Boxer* in the Persian Gulf, Marines board a CH-53E Sea Stallion helicopter in February 2003 during the buildup to Operation Iraqi Freedom (OIF). (U.S. Navy Chief Store Keeper Denise Depozo)



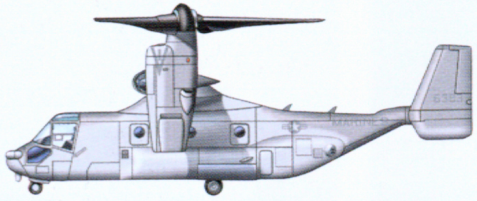
USS *Essex* (LHD-2) is depicted here as initially completed in 1992. She is painted in the then-standard US Navy color scheme of Haze Gray (FS 595B: 26270) vertical surfaces, Deck Gray (FS 595B: 36008) horizontal surfaces visible from above (other than those used for flight operations), Flight Deck Gray (FS 595B: 36076) landing areas, and Anti-Fouling Red (FS 595B: 31136) hull bottom. Boot topping (the area from minimum load waterline to twelve inches above maximum load waterline) is Black (FS 595B: 37038). Flight deck markings are Yellow (FS 595B: 33538) and White (FS 595B: 37875). The fifth US Navy ship to carry the name, *Essex* was built by Ingalls Shipbuilding, Pascagoula, Mississippi. She was launched 23 February 1991 and commissioned 17 October 1992. In October 1994 she began her maiden deployment, during which she participated in the withdrawal of the United Nations Multinational Force from Somalia. On her second deployment, *Essex* and the 11th Marine Expeditionary Unit (MEU) participated in multinational naval exercises off the coasts of Kuwait and Australia. During her third deployment, *Essex* supported Operation SOUTHERN WATCH, the enforcement of the UN-mandated no-fly zone over southern Iraq. On 26 July 2000, when she arrived at Sasebo, Japan, *Essex* replaced USS *Belleau Wood* (LHA-3) in the Navy's largest crew swap to date, as sailors simply switched ships and *Belleau Wood* returned to the United States. *Essex* remained in Sasebo as the Navy's only permanently forward-deployed amphibious assault ship, and participated in humanitarian assistance and disaster relief operations in East Timor in 2001 and Korea in 2002. In 2004 *Essex* carried the 31st MEU to Kuwait and stayed in the Persian Gulf while the 31st MEU went into Iraq for the Battle of Fallujah. While deployed in the Persian Gulf, she was ordered to Thailand to aid in humanitarian missions following the tsunami of 2005. After her return to Japan from the tsunami relief mission, she assisted with Philippines mudslide recovery efforts in February 2006. Since her commissioning, *Essex* has received numerous awards, including six Battle "E" awards. The ship's crest (left) displays her motto, "Take Notice." The phrase is taken from the advertising appeal for materials to build the first *Essex*, a thirty-two gun frigate launched in 1799, which compiled a battle record in the War of 1812 unequaled by any other man-of-war. As of mid-2006, USS *Essex* remained home-ported at Sasebo, Japan.

▲ The AV-8B Harrier is the primary close air support aircraft of the US Marine Corps. LHAs and LHDs normally carry six Harriers, although this can vary with the mission.

▲ The UH-1N is a twin-engine utility helicopter used in a variety of roles to provide support to the landing force commander during ship-to-shore movement and subsequent operations ashore. Normal ship's complement is four.

▲ The AH-1W Super Cobra is a day/night/marginal weather attack helicopter that provides escort for assault helicopters, fire support, and fire support coordination to the landing force. Normal ship's complement is four.

▲ The Boeing CH-46E Sea Knight is a medium-lift helicopter used to provide all-weather assault transport during amphibious operations and subsequent operations ashore. Normal ship's complement is twelve.



▲ The MV-22 Osprey is a tiltrotor vertical/short takeoff and landing aircraft which will replace the Marine Corps' current medium-lift helicopters (CH-46E and CH-53D).

▲ The CH-53E Super Stallion is the Marine Corps' heavy-lift helicopter, designed for the transportation of heavy equipment and supplies during the ship-to-shore movement of an amphibious assault and during subsequent operations ashore. Normal ship's complement is nine.

▲ The M1A1 is the Marine Corps' principal combat tank, and is equipped with a 120 mm cannon. One M1A1 can be carried at a time on an LCAC, two on an LCU.

▲ The AAV (Amphibious Assault Vehicle) is a fully amphibious armored personnel carrier capable of transporting twenty-five Marines in addition to its three-man crew.

All Illustrations on this page are to the same scale.

▲ The SH-60B Seahawk is twin turboshaft, multi-mission US Navy helicopter deployable aboard any air-capable ship of the fleet. Missions include anti-submarine warfare, undersea warfare, anti-surface warfare, naval special warfare insertion, search and rescue, vertical replenishment, and medical evacuation.

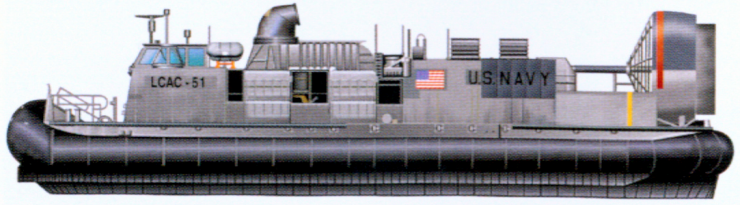
▲ The LAV-25 is an all-terrain, all-weather, night-capable vehicle, armed with 25 mm and 7.62 mm guns. It is air transportable by CH-53E and fully amphibious.

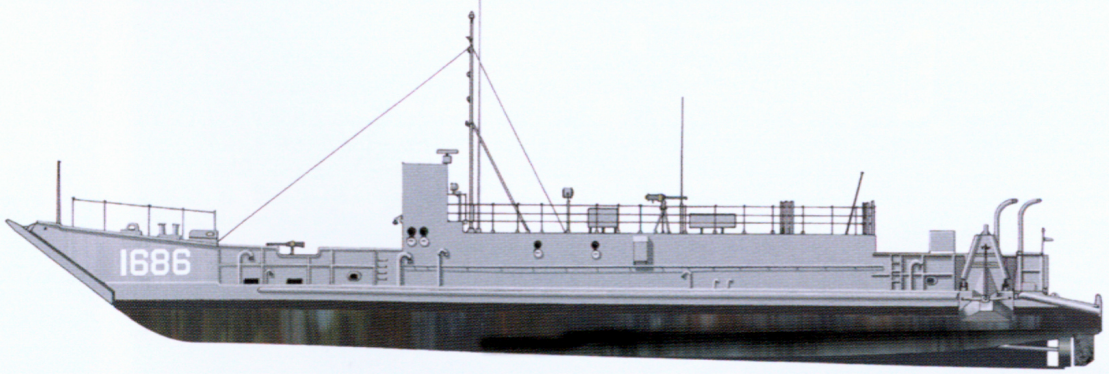
▲ The HMMWV (High Mobility Multipurpose Wheeled Vehicle) 'Hummer' is the standard light military truck. It is produced in several configurations.

▲ The M-109 self-propelled howitzer provides combat support with its 155 mm cannon. It is air transportable and can be fitted with an amphibious kit

▼ The LCU (Landing Craft, Utility) transports wheeled and tracked equipment and general cargo from ship to shore. It can carry 180 tons of equipment, 400 combat-equipped Marines, or two M1A1 Abrams tanks. It has a crew of ten.

▼ The LCAC (Landing Craft, Air Cushion) is a high-speed, fully amphibious hovercraft, capable of carrying a 60-75 ton payload at speeds over 40 knots. It is used to transport equipment, cargo, and personnel from ship to shore and across the beach.



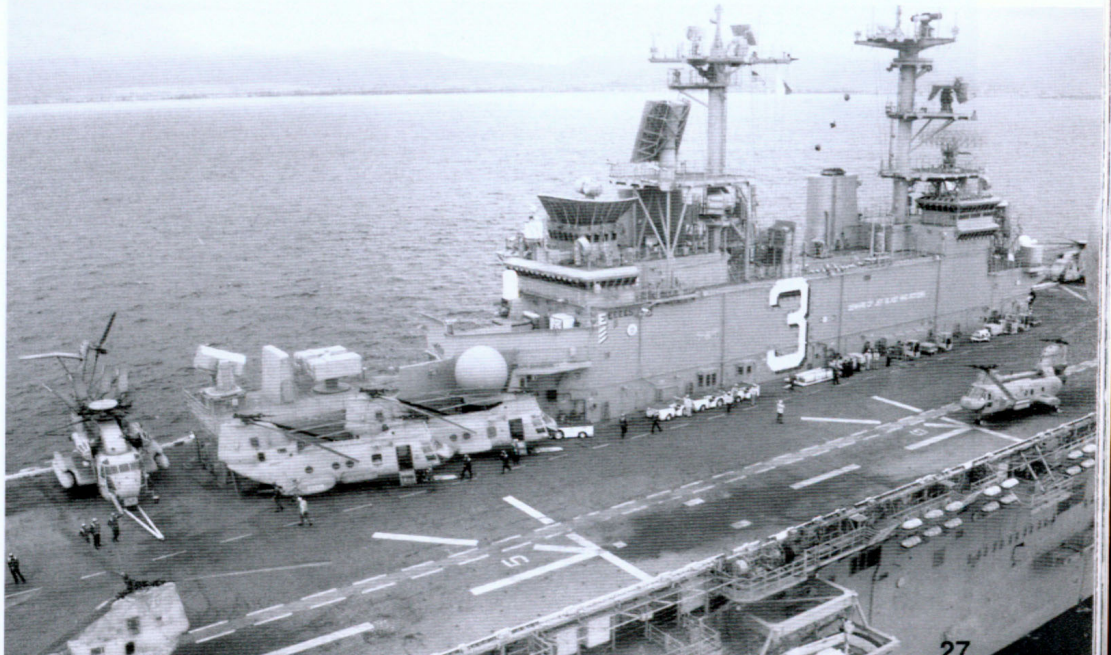


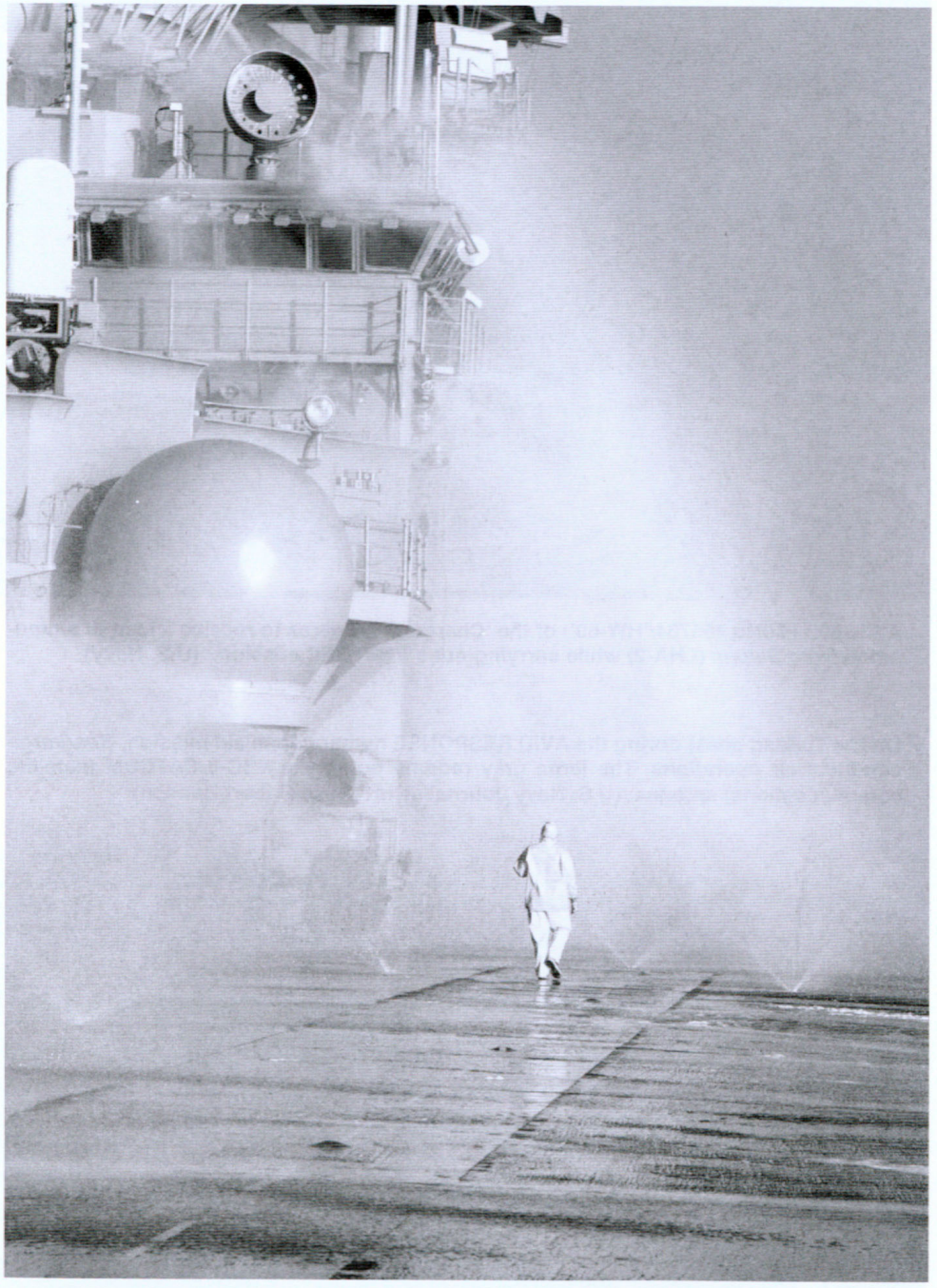
▲ V-22 Osprey tiltrotor aircraft practice landing approaches while *Iwo Jima* cruises in the Atlantic. Wings and engine nacelles fold for compact stowage onboard. (U.S. Navy Journalist 1st Class Mike Jones)

▲ A CH-60S (BuNo 165764/'HW-60') of the 'Chargers' prepares to receive a load of ammunition from *Saipan* (LHA-2) while carrying out a VERTREP mission. (U.S. Navy)

▼ During exercise PANAMAX 2005, an MH-53E Sea Dragon tows a Mk 105 Magnetic Influence Minesweeping System sled, seen here with hydrofoil fins raised. RHIB with crew stands by. *Bataan* awaits sled recovery. (U.S. Navy PM Airman Jeremy L. Grisham)

▼ Off the Turkish coast during the AVID RESPONSE humanitarian aid mission, *Kearsarge* conducts air operations. The large gray radome houses a WSC-6 SATCOM (satellite communications) antenna. (U.S. Navy Journalist 1st Class Rubert Benson)

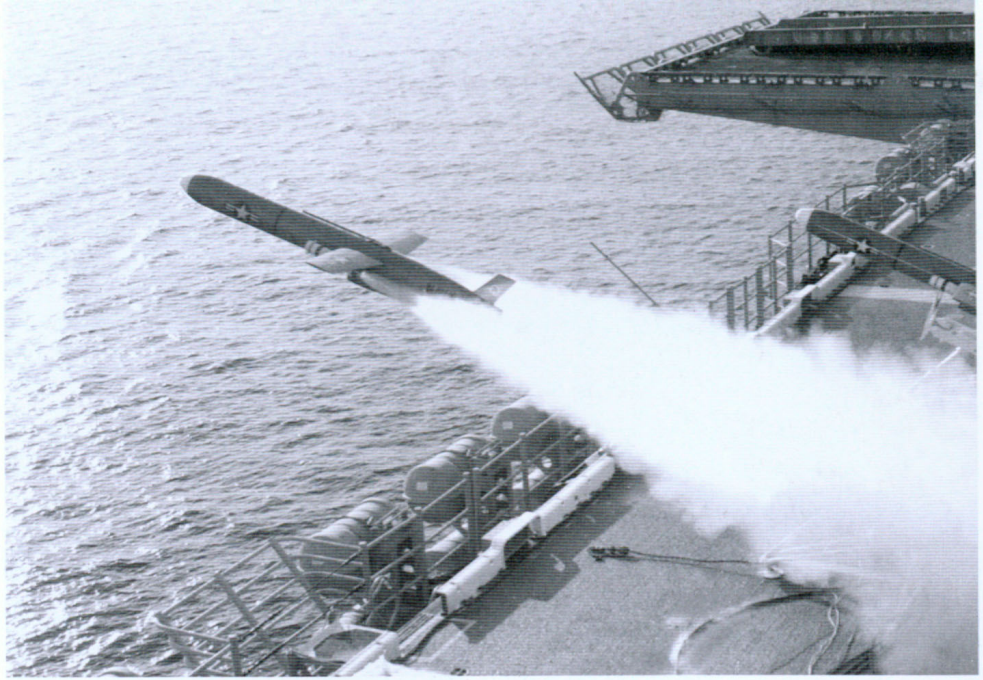




▲ *Boxer* undergoes operational testing of her CMWDS (Counter Measure Wash Down System). Water rinsing of the ship after a chemical attack dilutes substances and carries away agents that could incapacitate the crew and prevent normal ship operation. (U.S. Navy PM Airman Rudy Polach)

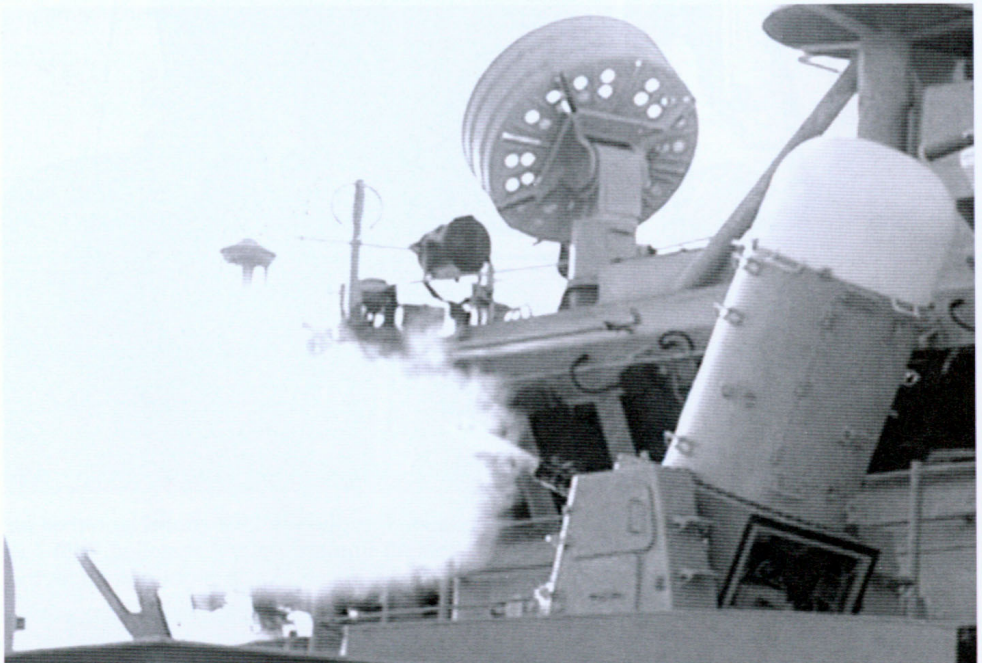
▲ With a Hallligan tool in right hand, a crash fire crew leader checks an AV-8B Harrier for hot spots after a simulated fire has been extinguished on board *Boxer*. The Harrier is a non-flying example. These drills keep crews proficient in emergency response tactics and teamwork while enhancing morale. (U.S. Navy PM 3rd Class Christopher Elmini)

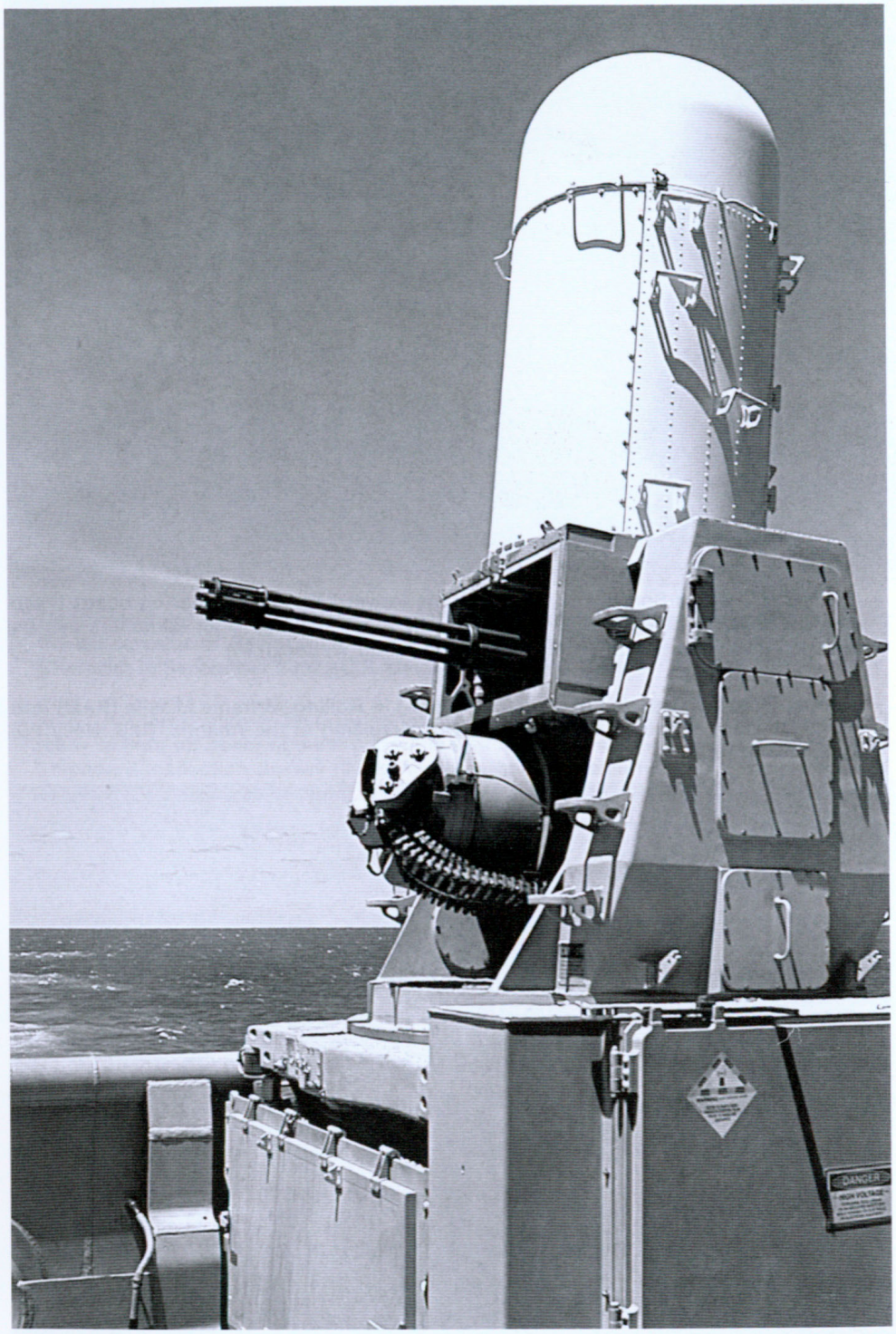
▼ At sea on *Boxer* as a fire crew prepares for an exercise. Turnout gear protects crew from heat. The nozzle is adjustable to create a fog or a straight stream pattern. Foam is used to to cut off fuel from air, extinguishing fires. (U.S. Navy PM 3rd Class Christopher Elmini)

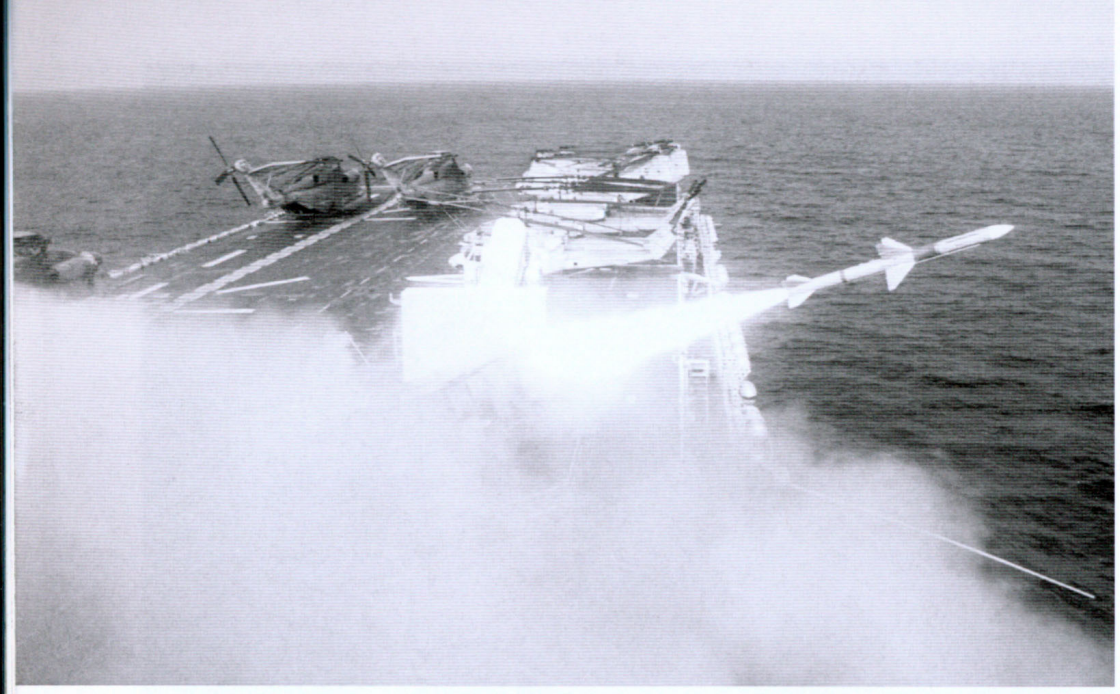


▲ A BQM-74E threat simulator is launched from the deck of *Boxer* during Cooperation Afloat Readiness And Training (CARAT) exercise held in Malaysia, in July 2005. BQM-74 is used to mimic cruise missiles. (U.S. Navy PM Airman Paul Polach)

▼ Close-In Weapon System (CIWS) firing on *Wasp* and (right) *Kearsarge*. Two radars in the cylindrical section above the gun track both the target and rounds fired, merging both tracks to destroy incoming aircraft or cruise missiles. There are two of these weapons, one forward and one aft, on all ships. (both U.S. Navy)

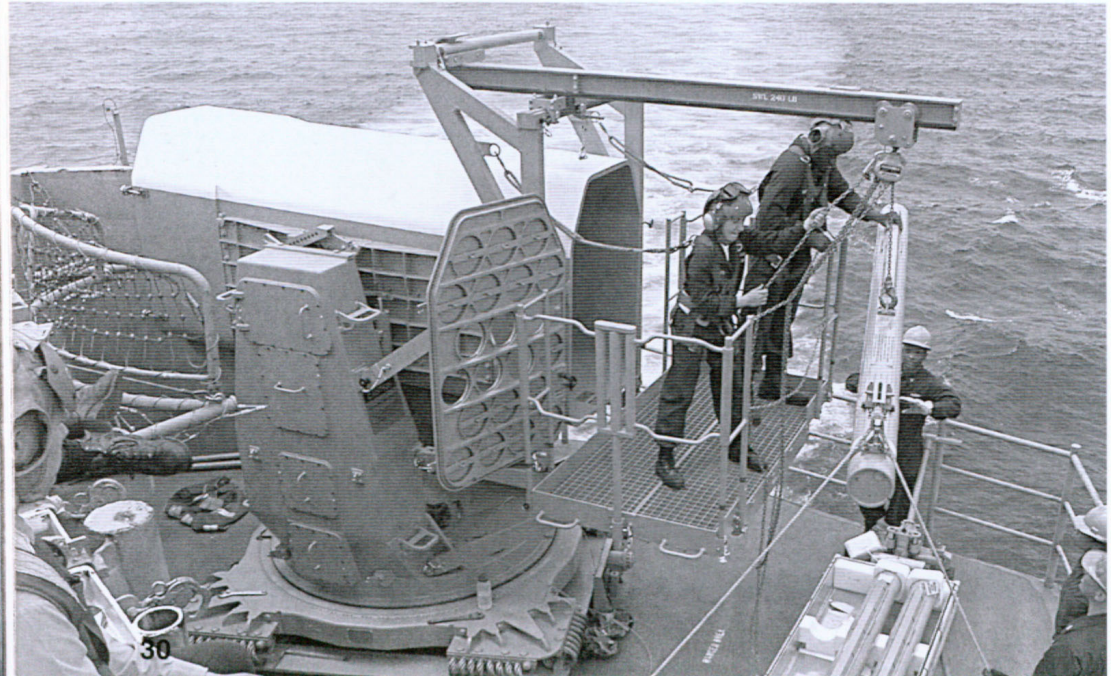


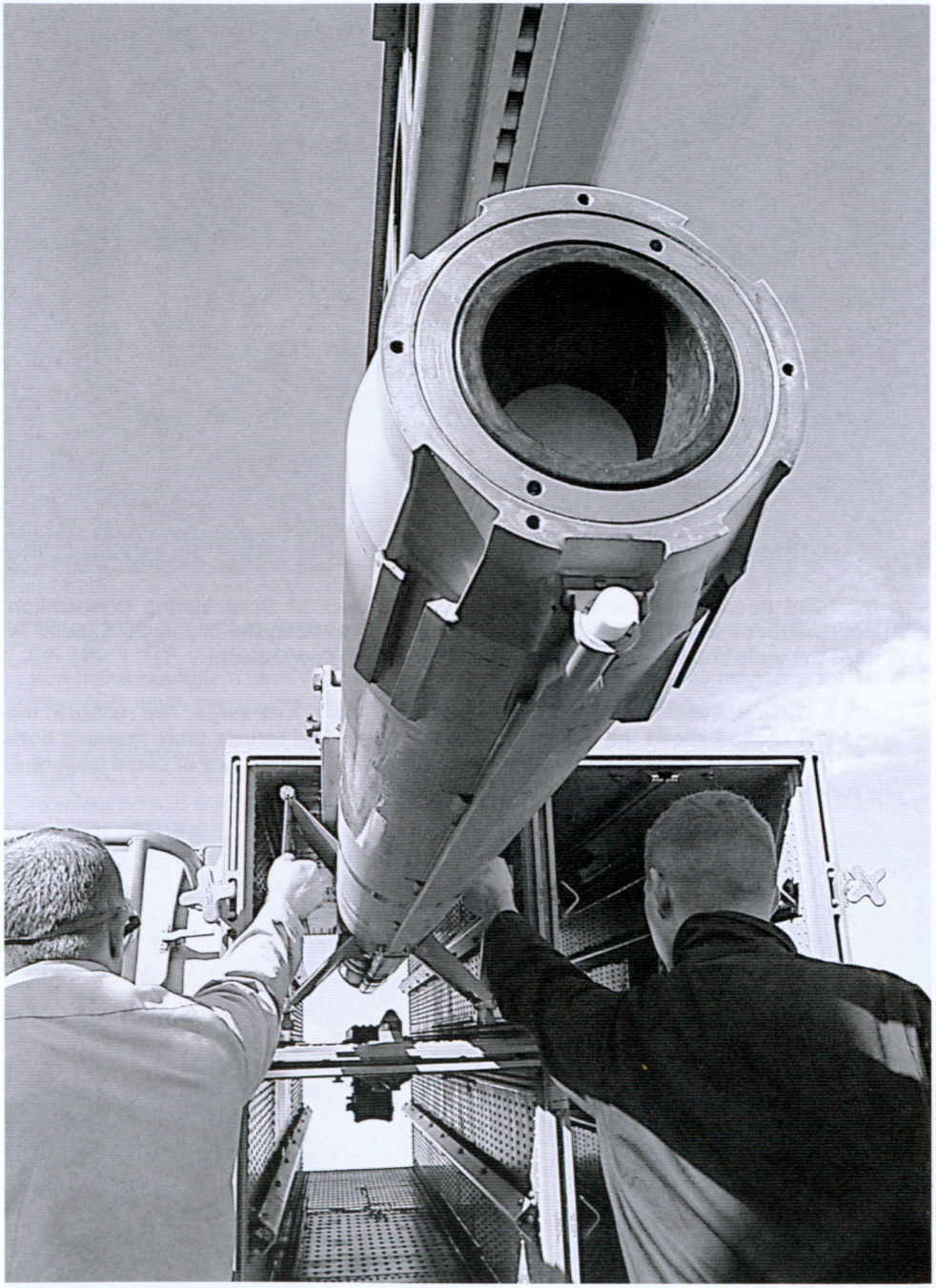




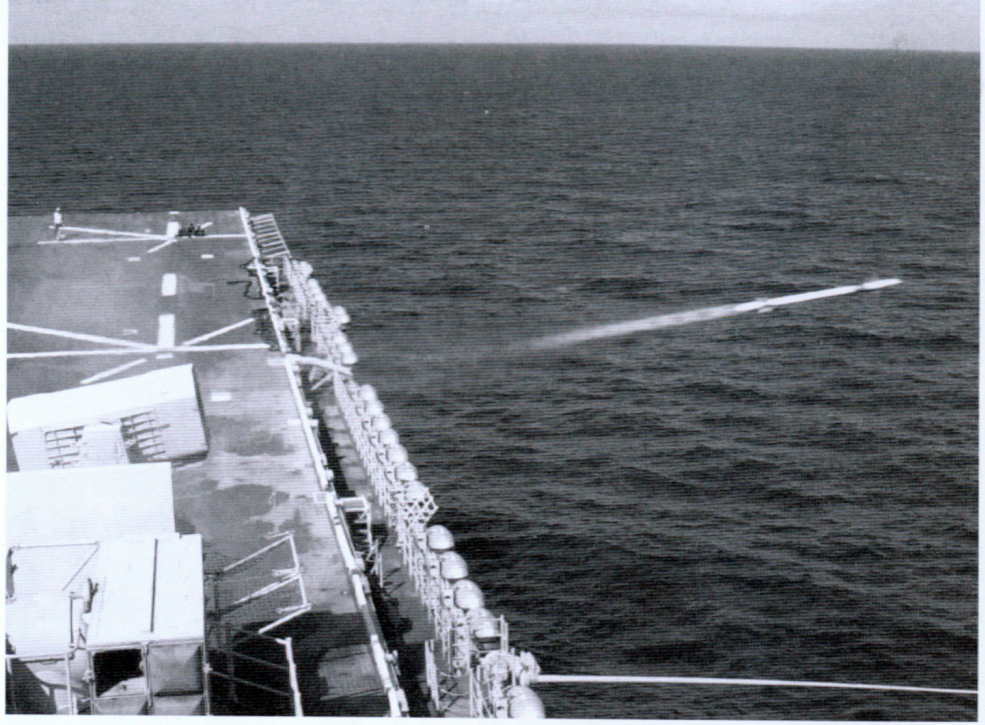
▲ A RIM-7 NATO Sea Sparrow is fired from the forward Mk 29 launcher on board *Wasp* during a SOCEX exercise. RIM-7 is in use by many nations. Both launchers can be reloaded when empty. (U.S. Navy PM Airman Aaron W. Lockhart)

▼ Combat Systems Department crew loads RIM-116 Rolling Airframe Missile (RAM) into Mk 49 21-round launcher on *Kearsarge* while cruising in the Atlantic. (U.S. Navy PM Kenny Swartout)





▲ Armorers load a RIM-7 NATO Sea Sparrow missile into the Mk 29 8-round launcher on board *Kearsarge* in February 2003. The missile's aft fins are not yet installed. RIM-7 is adapted from the AIM-7 Sparrow used by the U.S. Air Force. For in-flight guidance, the Mk 95 fire control radars are used. (U.S. Navy PM 2nd Class Alicia Tasz)

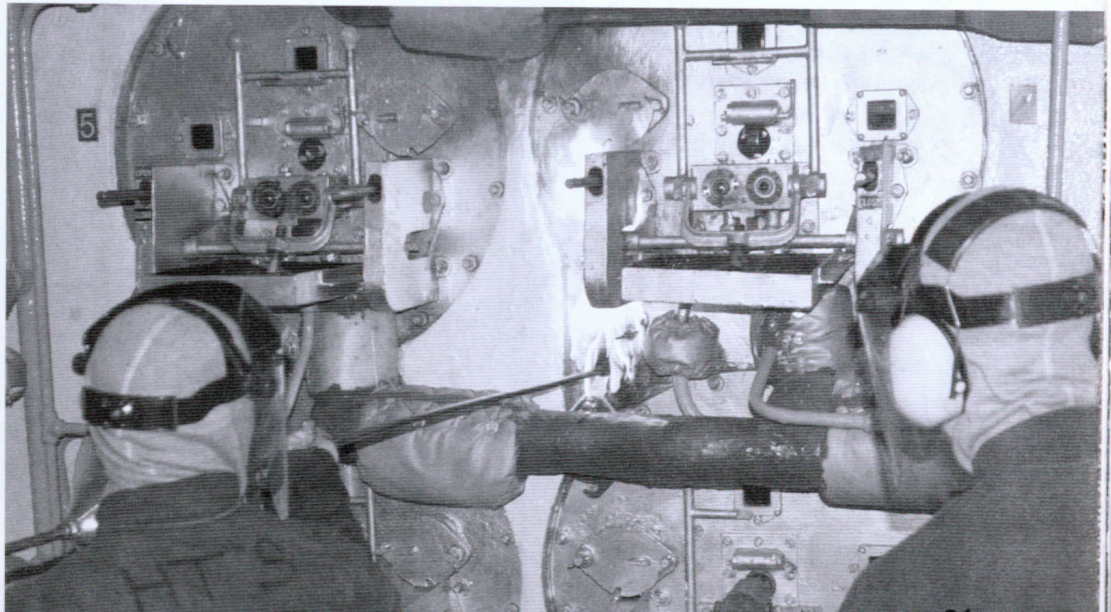


▲ RAM missile launches from *Bataan*. RAM is a short-range defensive weapon using Infrared guidance. (U.S. Navy PM Airman John Tauter)

▲ Members of the 31st MEU (Marine Expeditionary Unit) conduct small arms training on the aft elevator of *Essex* while at sea during a SOCEX (Special Operations Capable EXercise) in September 2002. (U.S. Navy PM 3rd Class Gary B. Granger)

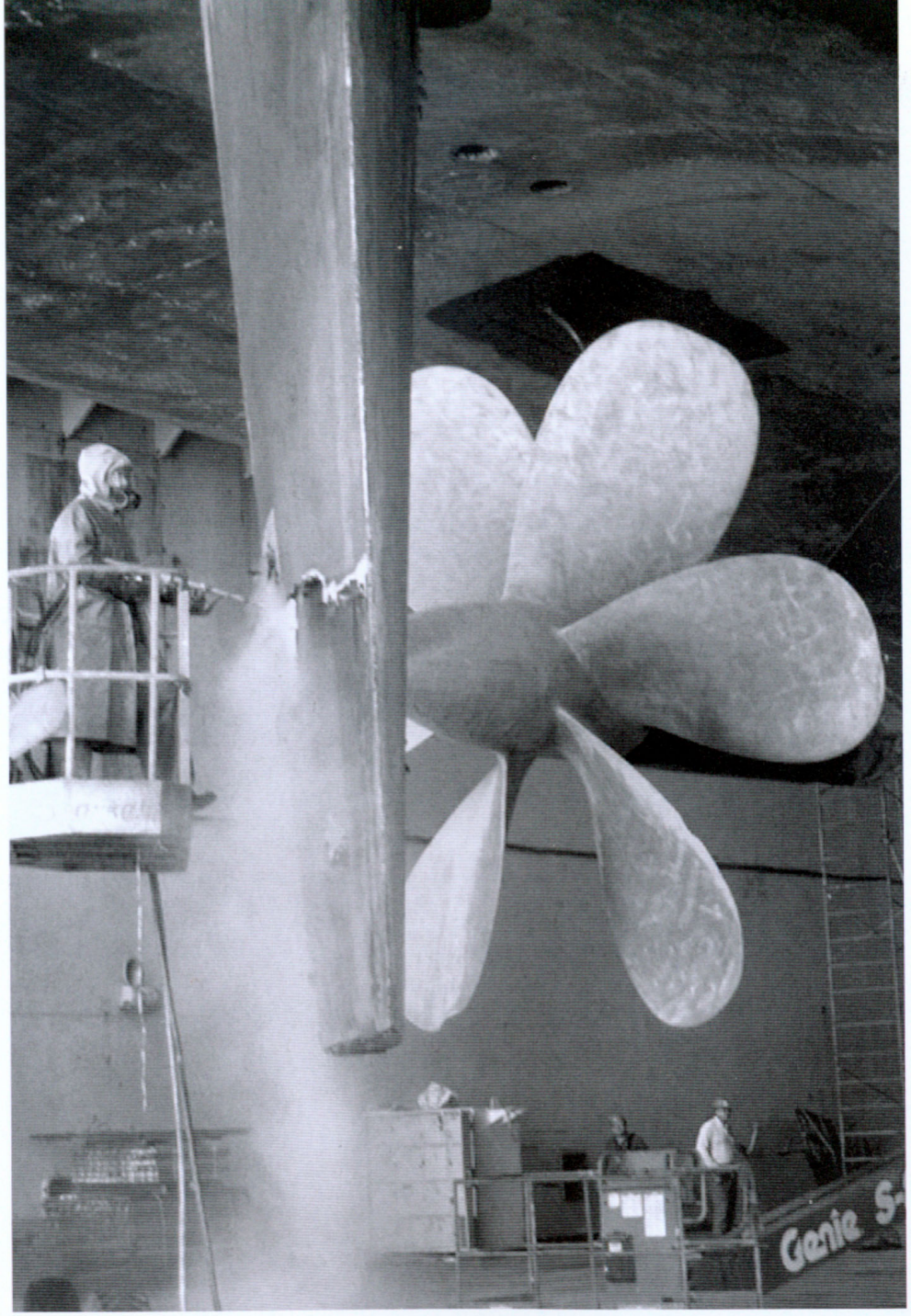
▼ Gunner's Mate Seaman Martinez fires a Mk-38 25 mm machine gun during training on board *Boxer*. This type weapon is effective against small craft and is regularly used in training to build morale and maintain gun crew proficiency. (U.S. Navy PM 3rd Class James Bartels)

▼ With a hot torch ready to be inserted into the firebox, firemen on board USS *Bataan* get ready to light off boiler number two while at Norfolk in October 2004, following a Navy Shipboard Inspection Survey (INSERV). Superheated steam reaches a temperature of 482 degrees Celsius. (U.S. Navy PM 3rd Class Casey L. James)



Inside the helicopter direction center of *Iwo Jima*, controllers monitor radar screens as airborne assets arrive and depart during Hurricane Katrina operations in September 2005. Radars in use include SPN-35 and SPN-43. (U.S. Navy PM 3rd Class Christian Knoell)

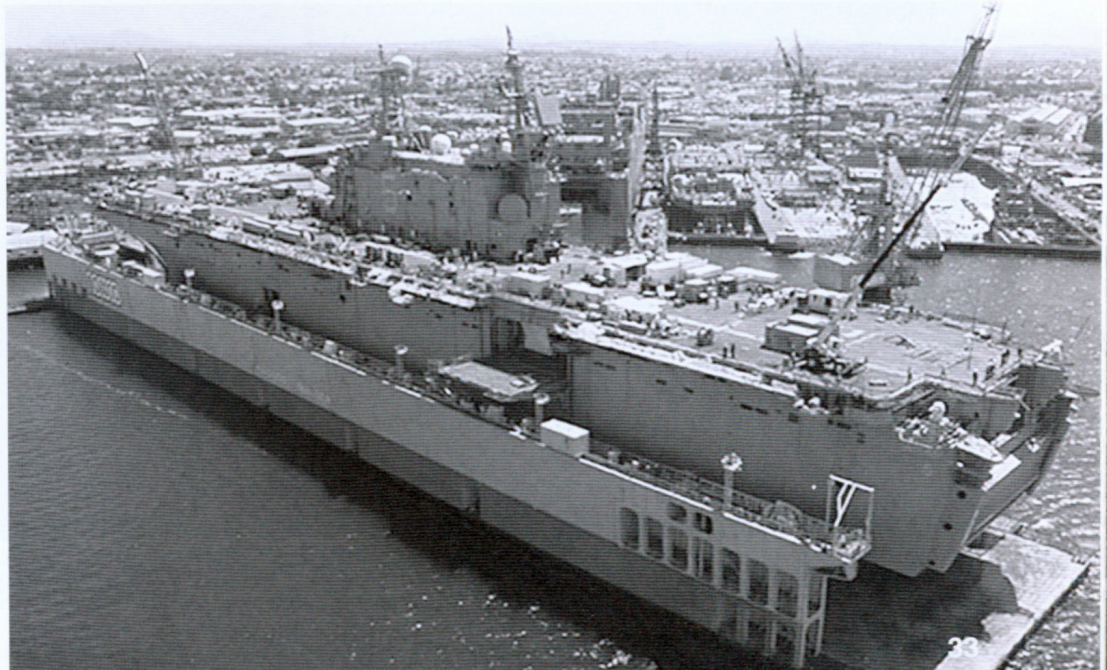
With the approach of Hurricane Rita, *Iwo Jima* departed the port of New Orleans to ride out the storm at sea. This is the scene on the bridge while the ship was underway in heavy seas in the Gulf of Mexico. (U.S. Navy PM 3rd Class Christian Knoell)



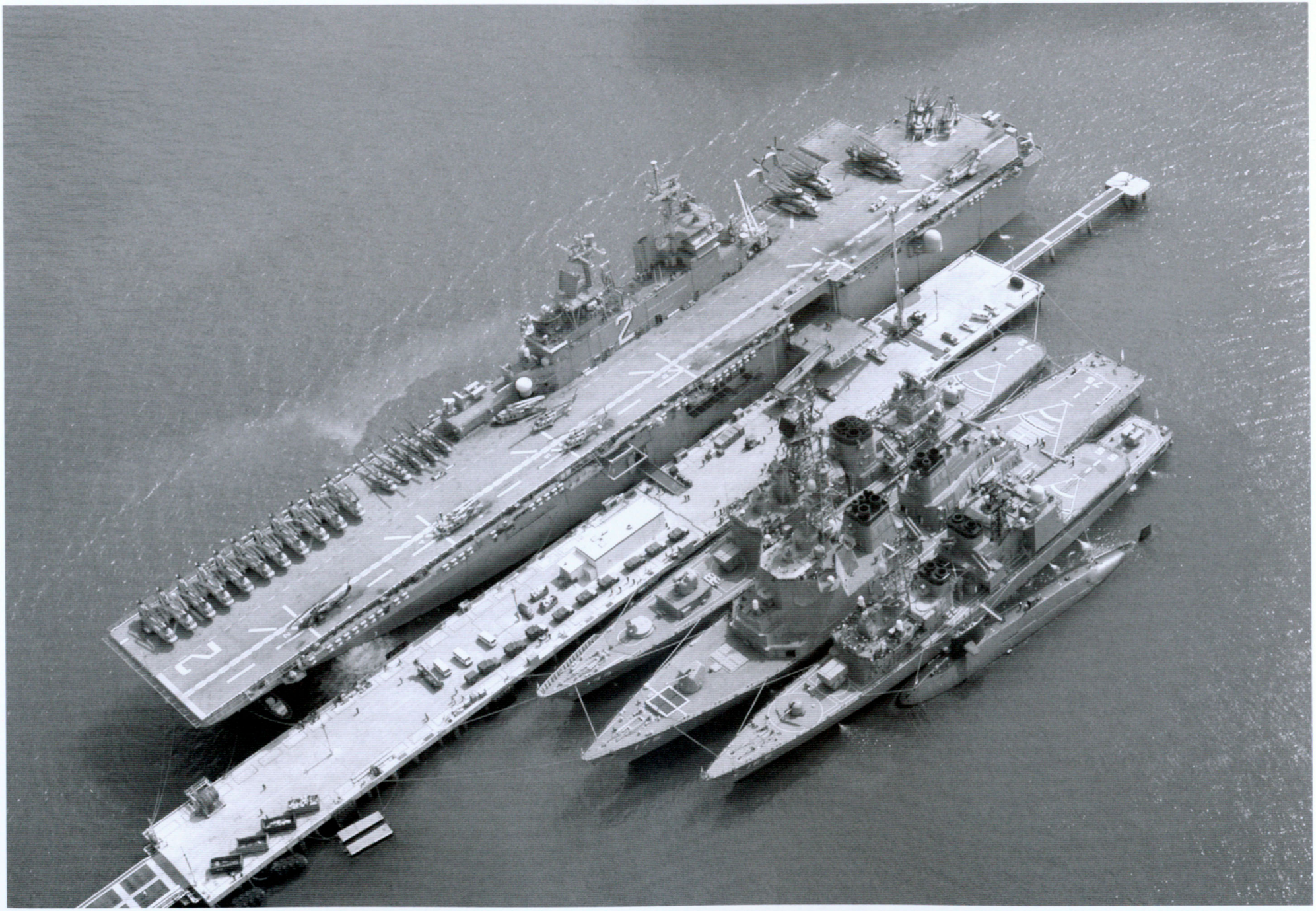
▲ *Belleau Wood* gets her rudder stripped during an overhaul. Hydro-blasting of rudder strips away marine growth and old paint and allows for a detailed inspection before a new coat of anti-fouling compounds is applied. (U.S. Navy PM 3rd Class Erika Jones)

▲ *Wasp* gets a fresh coat of paint on her bow. Painting is a constant duty of the crew of any sea-going vessel. (U.S. Navy PM Teresa Ellison)

▼ *Peleliu* in a floating dry dock during a major overhaul. These ships spend many months of their service lives high and dry on a scheduled basis while repairs are carried out, new equipment is installed, and modifications come due for completion. (U.S. Navy)



Iwo Jima In the Persian Gulf with AH-1s, CH-46s, CH-53s, and AV-8B Harriers aboard. Above the stern gate is defensive armament consisting of (from port to starboard) CIWS close-in guns, RIM-7 Sea Sparrow missile launcher, and RAM launcher. Behind the RAM mount is the SMQ-11A Meteorological Satellite receiving antenna. (U.S. Navy PM 3rd Class Kristi J. Earl)



Essex moored at White Beach Port Facility, Okinawa, in February 2003 with Japanese Maritime Self-Defense Force (JMSDF) surface ships JDS *Shimakaze* (DDG-172), JDS *Myoko* (DDG-175), JDS *Hamagiri (*DD-155), and submarine JDS *Natusio* (SS-584). Port visits to foreign nations and joint exercises familiarize allied naval forces with each other's tactics, equipment, and operational doctrine. (U.S. Navy PM 1st Class James G. McCarter)

With *Tarawa* leading *Saipan* (port) and *Kearsarge* (starboard), *Boxer* and *Bataan* are joined by *Bonhomme Richard* for a group portrait in the northern Persian Gulf. These ships were part of Combined Task Force 51 (CTF-51) in April 2003 during Operation Iraqi Freedom. (U.S. Navy Chief PM Tom Daily)

For any navy to have a global presence at sea, replenishment of food, fuel, spare parts, and oil while underway is essential. This is the scene on *Boxer* while taking on fuel from the replenishment oiler USS *Rappahannock* (T-AO 204) in the Pacific Ocean in May 2005. *Rappahannock* has a crew of Navy and civil service mariners. Fuel capacity of the oiler is 159,500 barrels (more than five million gallons) contained in twenty-seven hull tanks. (U.S. Navy)

▲ With Australian S-70 Blackhawk helicopters aboard and one making an approach, *Boxer* launches an LCAC in Shoalwater Bay, Australia, during exercise TALISMAN SABRE in June 2005. Aft elevator is raised. Large radome on starboard platform houses WSC-8 'Challenge Athena' antenna. (U.S. Navy PM 3rd Class James F. Bartels)

▶ *Iwo Jima* docked in New Orleans days after Hurricane Katrina struck. The ship provided food, showers, a staging area for supply distribution, and facilities to coordinate recovery efforts.

Sheraton
Hilton
R I V E R W A L K

▲ An MH-60S departs after dropping off a load of humanitarian supplies. Additional helicopter assets and supplies for Hurricane Katrina relief were provided by *Bataan*. First warship on the scene, *Bataan* co-coordinated relief efforts offshore. (U.S. Navy PM Airman Amanda M. Williams)

▲ LCAC 86 makes its way to the open well deck of *Iwo Jima* with vital equipment while Task Force Katrina is still at sea, en route to the stricken New Orleans region. (U.S. Navy Petty Officer 3rd Class Christian Knoell)

▼ 'Marine One,' a VH-60N Whitehawk with President Bush onboard, approaches *Iwo Jima* for a visit by the Commander-In-Chief. (U.S. Navy PM 2nd Class Robert J. Stratchko)

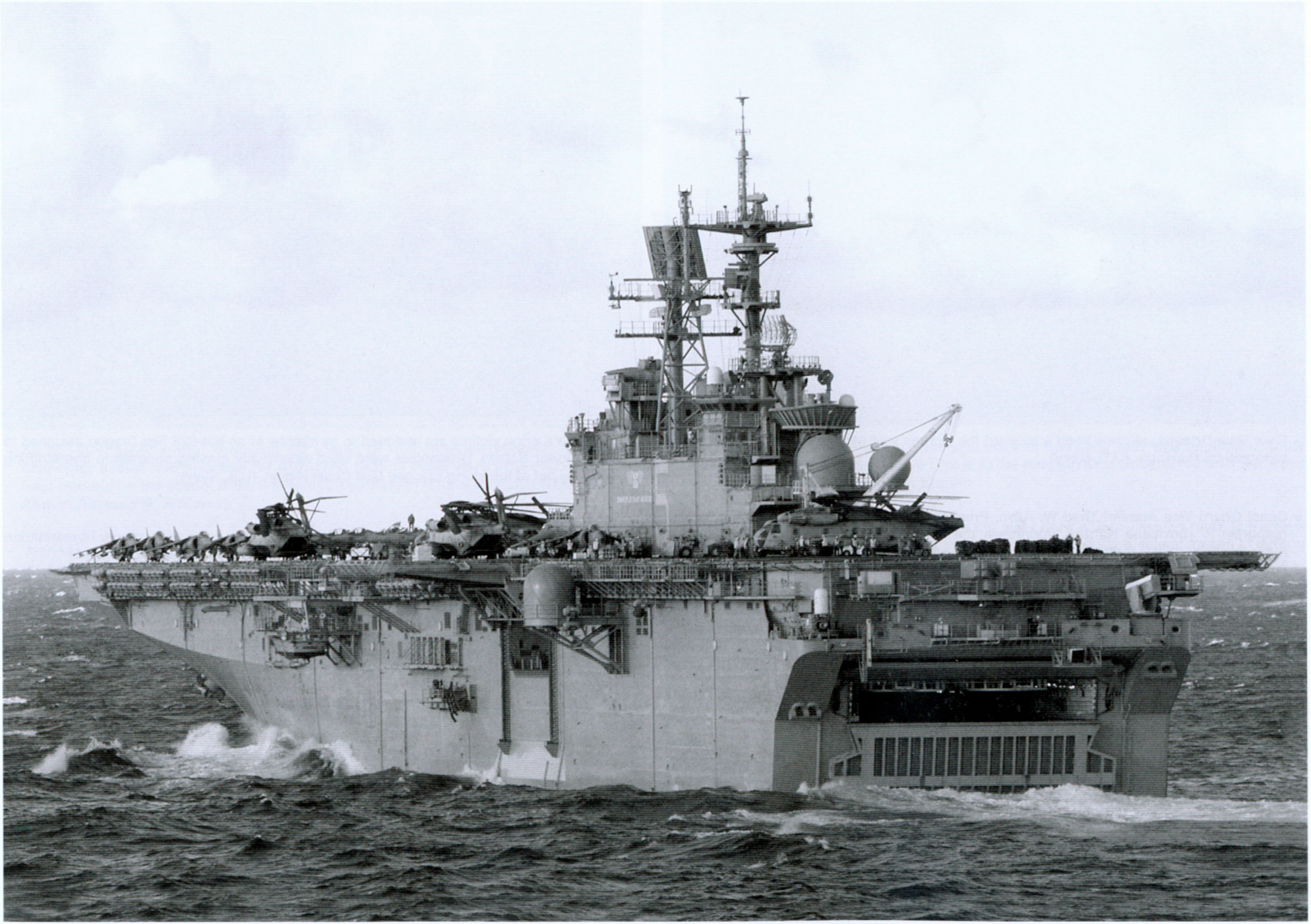
▼ Pallets of supplies ready to distribute on the flight deck of *Iwo Jima*, en route to the New Orleans area after Hurricane Katrina. Helicopters provided the quickest means of getting cargo where it was needed. (U.S. Navy)

▲ Over New Orleans, aircrew keep a lookout for victims and other aircraft while en route to logistical taskings. (U.S. Navy)

▲ Hurricane Katrina victims are attended to by aircrew of an MH-53E Sea Dragon assigned to HM-5 aboard *Bataan*. Helicopters were used extensively moving supplies in and airlifting evacuees out of the storm-ravaged Gulf Coast region. (U.S. Navy)

▼ Coast Guard Vice Admiral Thad W. Allen, Principle Federal Official (PFO) for the federal response to Hurricane Katrina, addresses the crew of *Iwo Jima* on the hangar deck regarding their efforts during the cleanup and recovery. (U.S. Navy PM Amanda M. Williams)

▼ Sailors assigned to *Iwo Jima* survey damage below while en route to render humanitarian assistance in the storm's aftermath. (U.S. Navy PM Airman Amanda M. Williams)

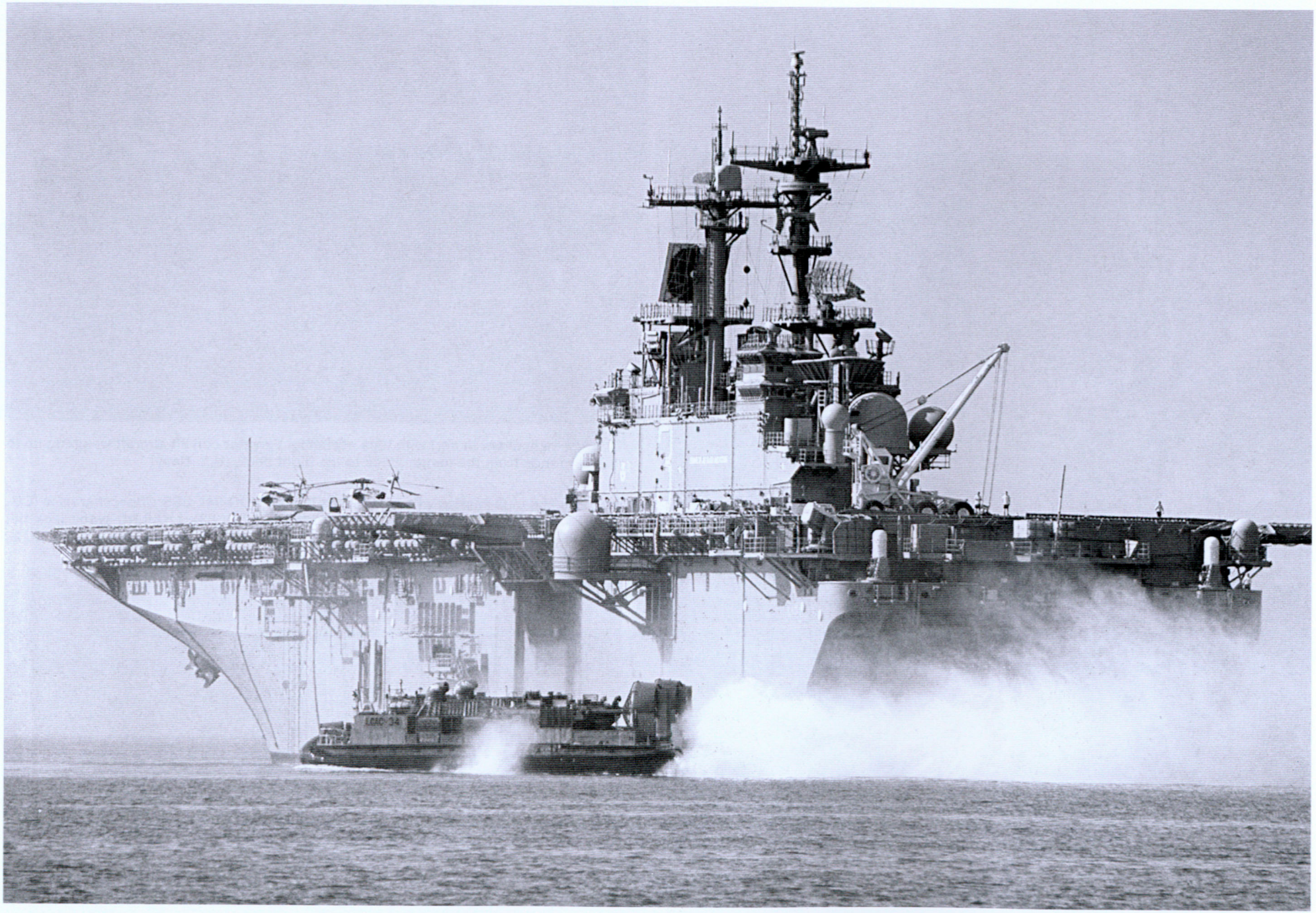


Bataan underway in the Mediterranean Sea as part of Amphibious Task Force-East (ATF-E) in January 2003. Three CH-53E choppers are spotted on the flight deck, one with its tail boom and main rotor blades folded. (U.S. Navy PM Airman Kenny Swartout)

▲ *Kearsarge* shows the squared-off flight deck of the LHD-class ships. The enclosed 'hurricane' bow has been a standard feature of all aircraft carriers since World War II. (U.S. Navy PM 3rd Class Angel Roman-Otero)

▲ *Iwo Jima* maneuvers in port with tugs assisting. Elevator can lift aircraft weighing up to 64,000 pounds from the hangar deck to the flight deck. (U.S. Navy)

▼ *Boxer* steams in formation with USS *Curtis Wilbur* (DDG-54), USS *Chancellorsville* (CG-62), USS *Fitzgerald* (DDG-62), and USS *Kitty Hawk* (CV-63). LHA/LHD types lack the arresting gear, angled deck, and catapults of the CV and larger CVN class carriers. (U.S. Navy Chief PM Todd Cochonowicz)



LCAC 34 departs for shore from well deck of *Kearsarge* (LHD-3). Speed of LCAC is valued for efficiency as well as minimizing exposure to hostile interference while landing operations are underway. Defensive armament of the LHD is well-suited to protecting the many small vessels in motion around it. A wide array of guns and missiles plus AV-8B aircraft and AH-1 helicopters provide a layered defense during amphibious operations. (U.S. Navy)

Shipboard Electronics

One consistent feature of these two classes of warship is the abundant array of antennas, radars, and radomes that proliferate the superstructure, island, and decks. Without all this equipment, there could be no contact with vessels at sea, aircraft could not land, weather could not be forecast, threats could not be seen, and weapons could not be guided once launched. The U.S. Navy has been at the forefront of using radio signals to communicate with ships at sea, beginning early in the last century. A major advance in technology later on was the adaptation of radar for use aboard ships during World War II. The most recent innovation, put to use on board every class of warship, is satellite communications (SATCOM). SATCOM enables fleet units to keep in constant contact with headquarters through the reception of fleet broadcasts and the transmission of status reports. SATCOM links also help build and maintain crew morale by affording television reception, marine telephone links, and e-mail from home.

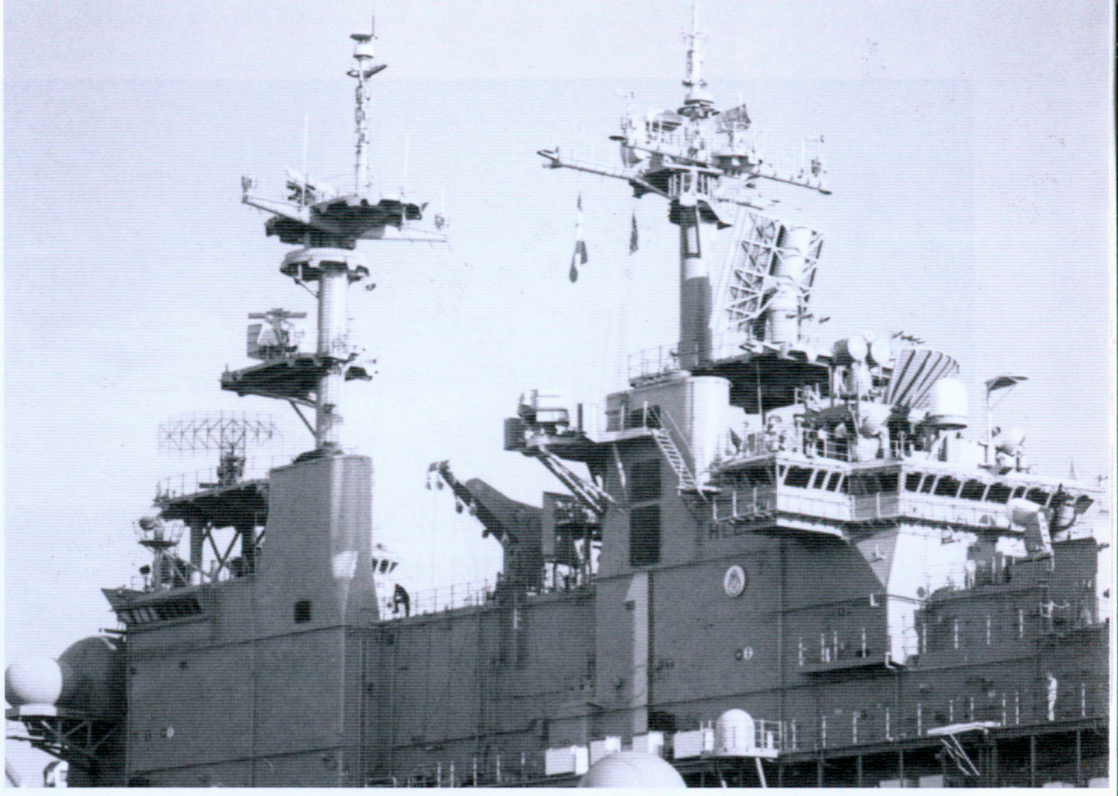
With all the electronic activity present — including tracking and approach radars, SATCOM terminals, surveillance and navigation radars, and fire control and data link signals — there is a performance penalty in the form of electronic interference. Accordingly, systems are intentionally degraded so that the operation of one does not adversely affect others, thus allowing the simultaneous operation of many systems at once. Radars and SATCOM terminals are located on the ship during the design phase and in yard overhauls to allow for minimal blockage from the ship masts and superstructure, and to isolate them from other equipment. In many cases, there are two or more of some systems in order to provide a measure of redundancy in case one fails or is damaged in combat. Electronic technicians use test equipment to isolate faults and perform maintenance whenever possible, whether at a port of liberty, at sea in calm conditions, or in various sea states as necessary.

As a result of the constant advances in electronics, modifications to original equipment are continuously ongoing. Antenna shapes change, and radomes get larger to accommodate bigger antennas able to collect more data faster. Warships of the same class may have different electronics, depending on the date of the latest overhaul and added gear necessary for specialized missions.

Current innovations include enclosed masts, which create a reduced radar signature and protect radars from the corrosive sea environment and harsh weather, while at the same time concealing equipment for security reasons. Antennas may be of the conformal type, flush with the deck sides. Signal beam patterns are also more carefully controlled to give faster and more accurate targeting data, which also results in less susceptibility to interception by hostile sensors.

Voice	**Function**
HF	Large discage antenna for HF communication. On LHA Class.
UHF	For UHF communications. Mounted high on yardarms or masts.

Radars	**Function**
Mk 23 TAS	Used for Target Acquisition and tracking.
Mk 95	Used to guide RIM-7 Sea Sparrow missiles.
SPN-35	Used to control aircraft while landing.
SPN-43	Used for air traffic control near ship.
SPS-40	Long-range search radar provides target bearing and range.
SPS-48	Long-range search radar provides target bearing and range.
SPS-49	Long-range search radar provides target range, azimuth and elevation.
SPS-64	Navigation radar.
SPS-67	Navigation radar.



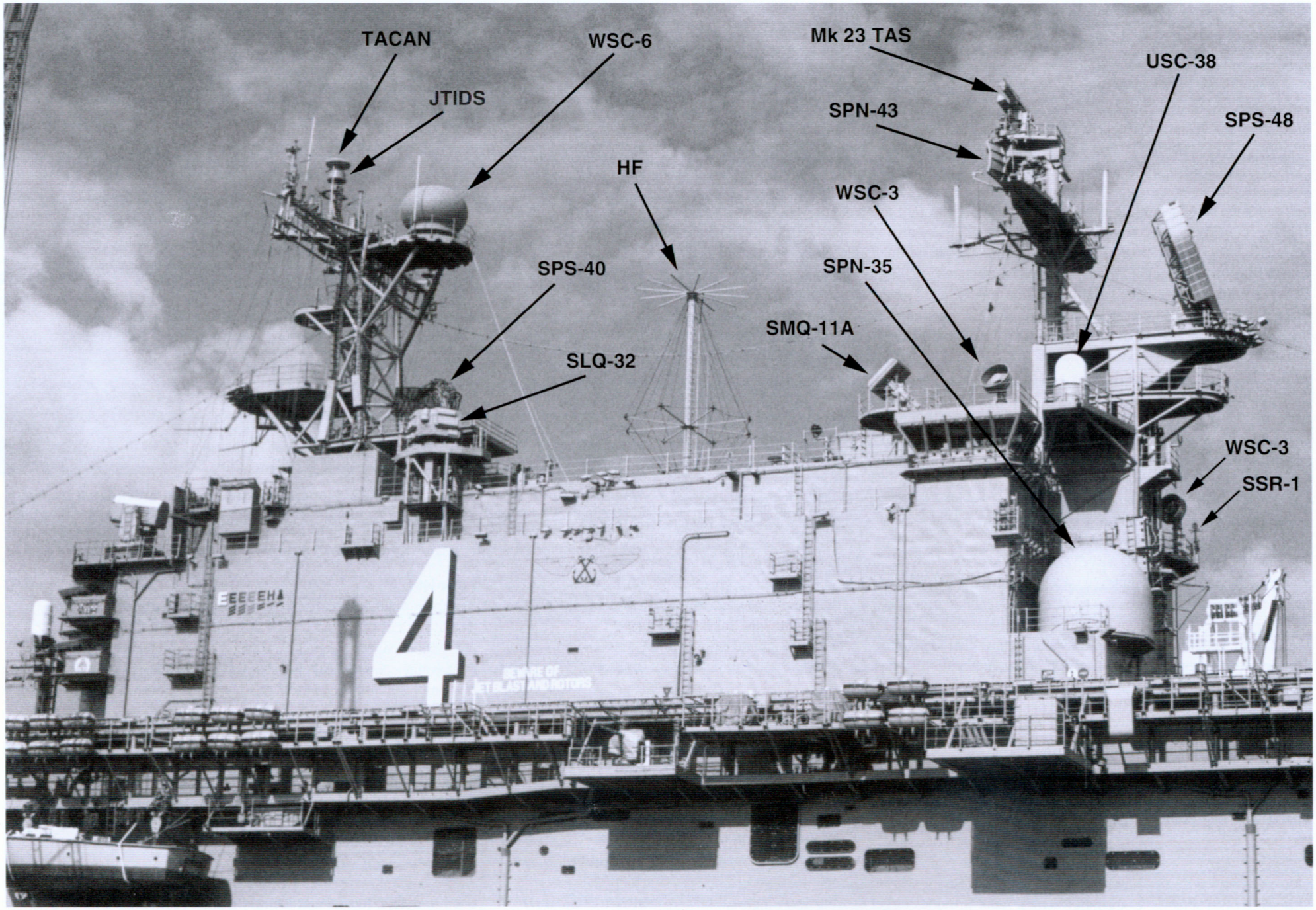
***Wasp*'s antenna array as of August 2003. Modern warships sprout antennas from every available space on their superstructures, and the *Tarawa* and *Wasp* classes are no exception. The electronics revolution not only has brought about changes in naval tactics, but also has made shipboard duty easier for the crew. (Author)**

SATCOM	**Function**
SMQ-11/SMQ-11A	Receives weather data from meteorological satellites.
SSR-1	Receives fleet broadcasts.
USC-38	For satellite communications in Extremely High Frequency (EHF) band.
WSC-3	For satellite communications in Ultra High Frequency (UHF) band.
WSC-6	For satellite communications in Super High Frequency (SHF) band.
WSC-8	For wideband commercial satellite communications.

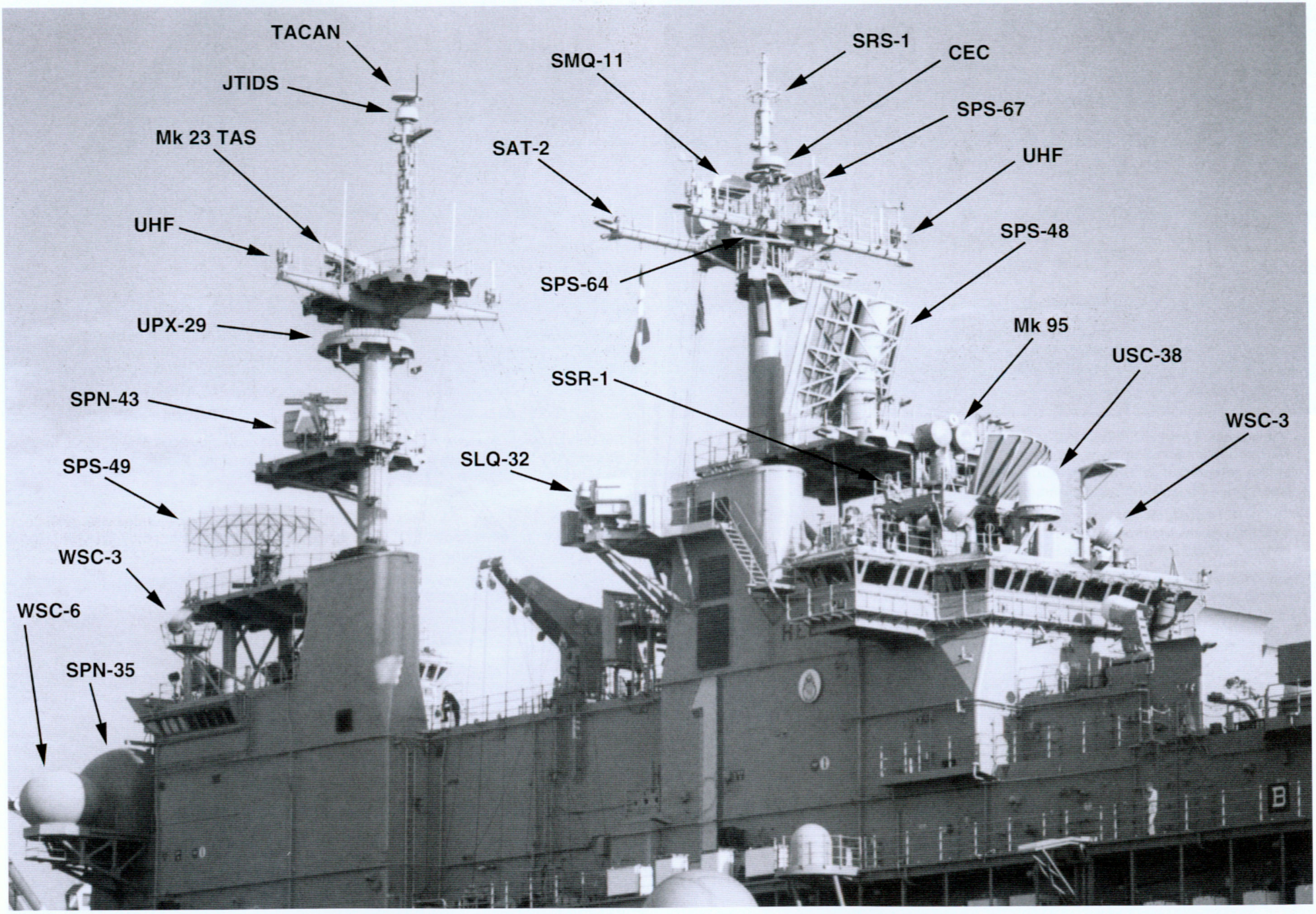
Data Links	**Function**
CEC	Data link antenna used in Co-operative Engagement Capability.
JTIDS	Data link antenna used in Joint Tactical Information Distribution System.
TACAN	Used for TACtical Air Navigation.

Electronic Warfare	**Function**
SLQ-32	Active antenna array used in electronic warfare.
SRS-1 Combat DF	Used to detect, locate, and identify hostile radio emissions.

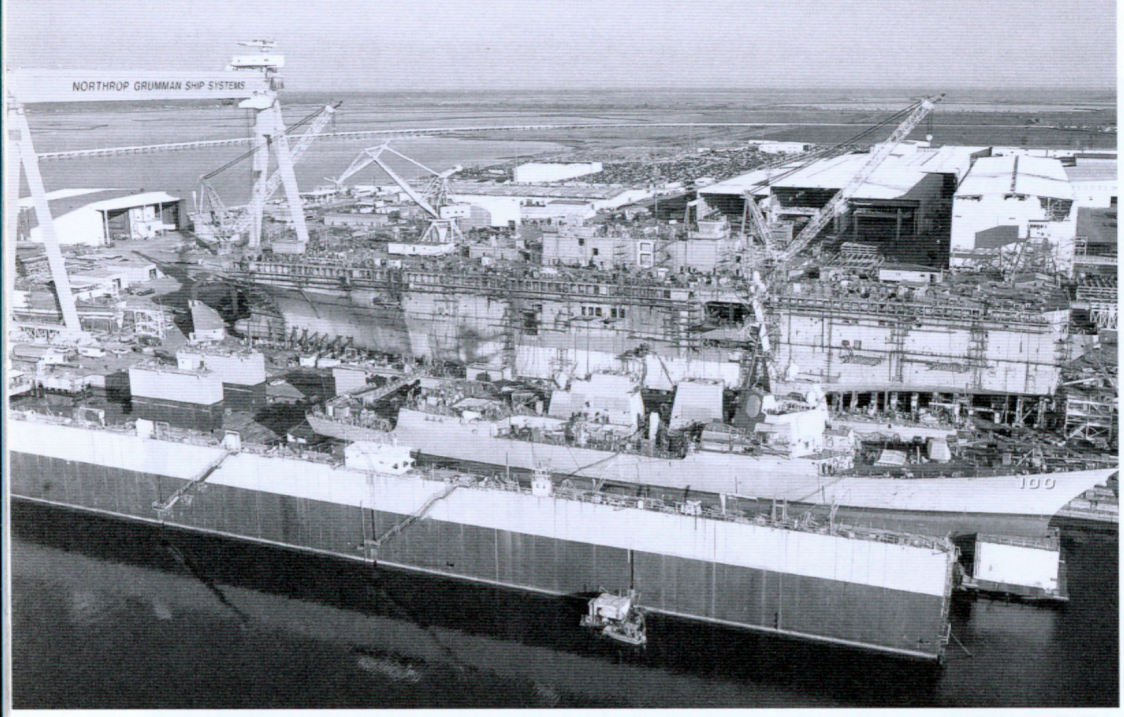
Infrared Blinker	**Function**
SAT-2	Blinker for Morse code messages in the infrared band.



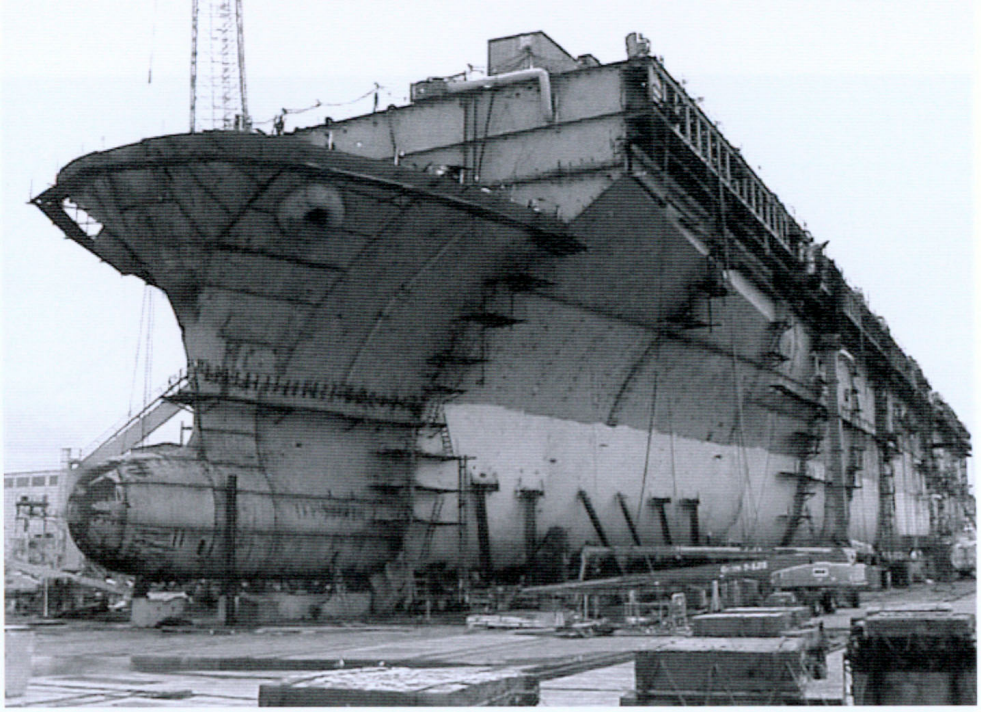
The electronics fit of *Nassau* (LHA-4) in May 2000. Most of the command and control facilities in the LHA, including the combat information center and the Integrated Tactical Amphibious Warfare Data System, are operated by a 100-man Operations Department, staffed by radarmen, air controlmen, aerographer's mates, photographer's mates, electronics technicians, data systems technicians, and data processers, and directed by an operations officer. (Author)



Radar and communications gear bristle from the island structure of USS *Wasp* (LHD-1), seen here in August 2003. Compared to the *Tarawa* (LHA) class, LHD's island is smaller with a lower silhouette. A forty-five-man Communications Department, staffed with radiomen and signalmen and headed by a Communications Officer, is responsible for repair and maintenance of all electronic and visual communications equipment aboard the ship. (Author)



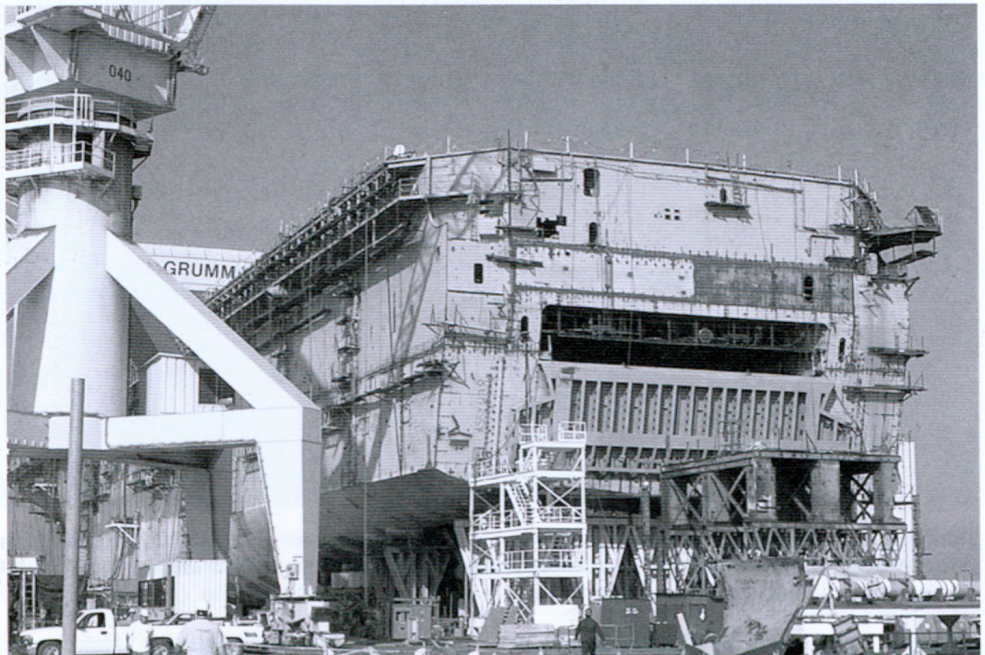
▲ The newest of the LHD Class, USS *Makin Island* (LHD-8) is seen here under construction at Northrop Grumman Ship Systems, Pascagoula, Mississippi, in December 2005. In dry dock in the foreground is USS *Kidd* (DDG-100), undergoing repairs to damage suffered in Hurricane Katrina. (Northrop Grumman)

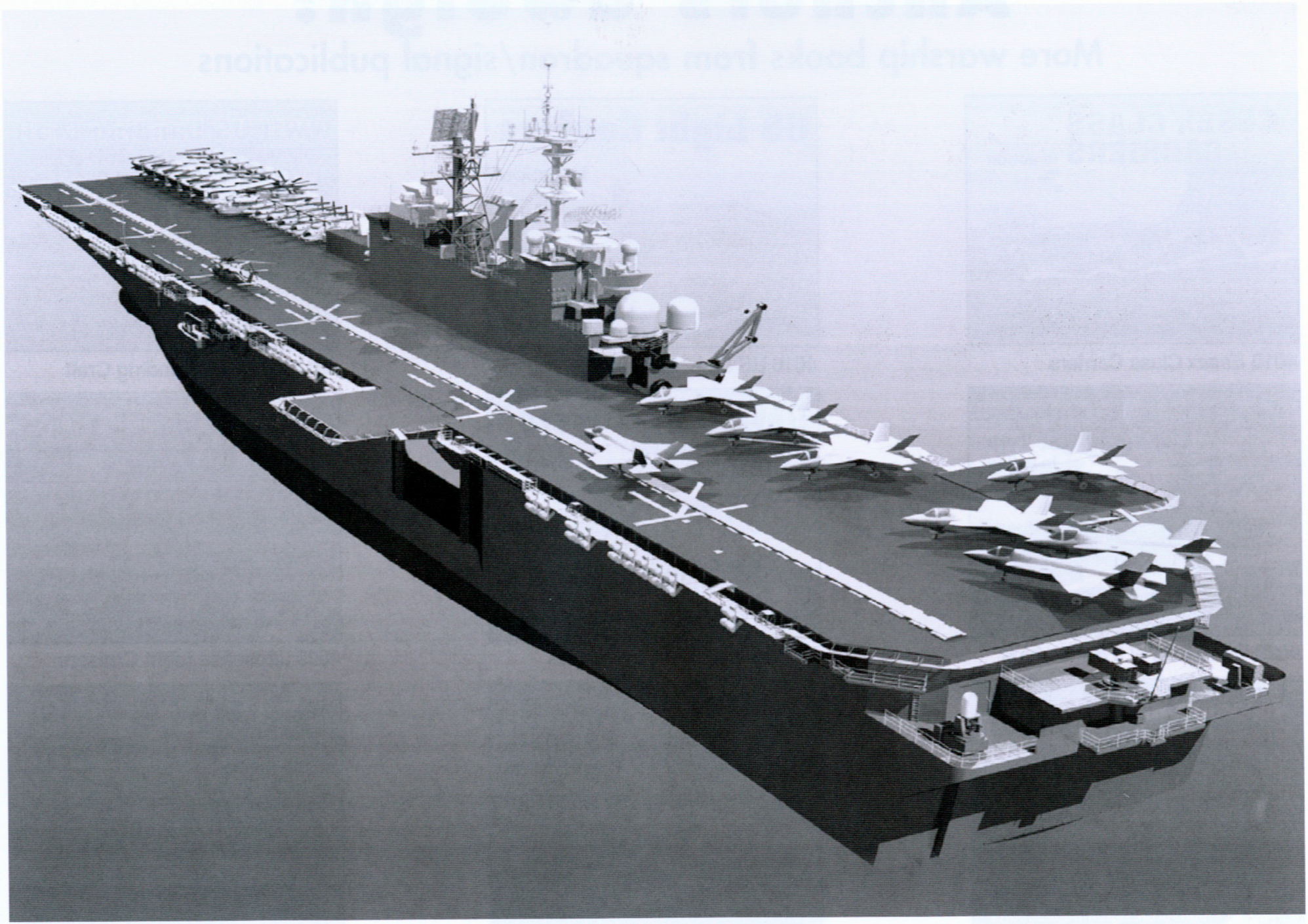


▲ The bow of *Makin Island* is seen here under construction in July 2005. The bulbous forefoot aids stability in rough seas and houses mine avoidance sonar. (Northrop Grumman)

▼ The port rudder of *Makin Island* after installation. The first LHD to be built with gas turbine engines and electric drive, *Makin Island* also will be the first all-electric LHD. No steam will be used on board the ship for heating or water production. (Northrop Grumman)

▼ This port quarter view of *Makin Island* in October 2005 shows the hinged well deck door. The smaller, top door has not yet been fitted. Note relative size of shipyard workers and pickup trucks at bottom of photo. (Northrop Grumman)

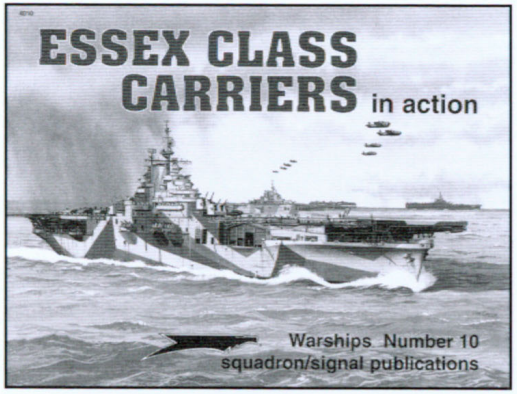




LHA(R) is shown in this conceptual image. Based on the LHD-8 design including gas turbine engines, LHA(R) will feature increased aviation capability to accommodate F-35B and MV-22 aircraft, increased cargo/magazine lifting capacity, better survivability, and increased habitability standards in a longer and wider hull. (Northrop Grumman Corp.)

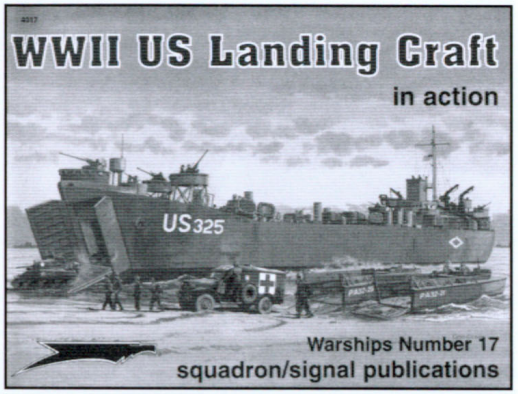
Anchors aweigh!

More warship books from squadron/signal publications



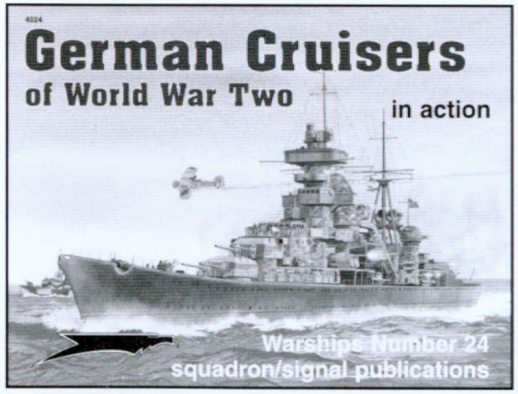
4010 *Essex* Class Carriers

4016 US Light Carriers

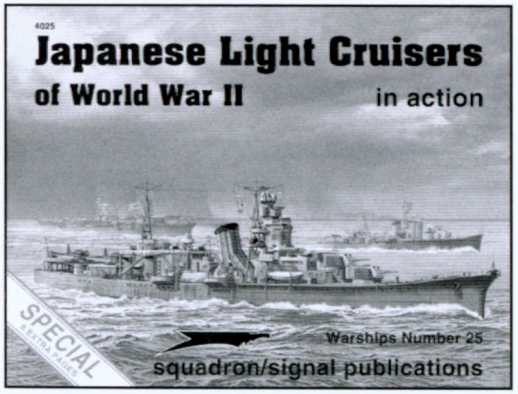


4017 WW II US Landing Craft

4023 German WW II Battleships

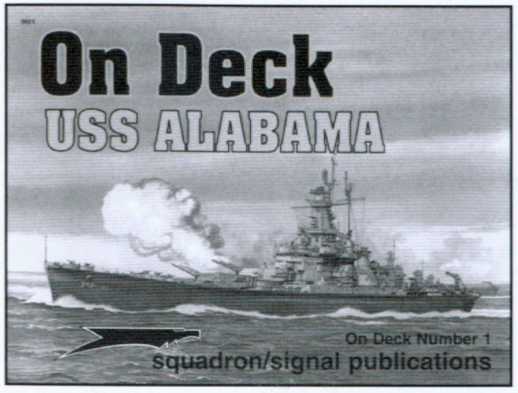


4024 German WW II Cruisers

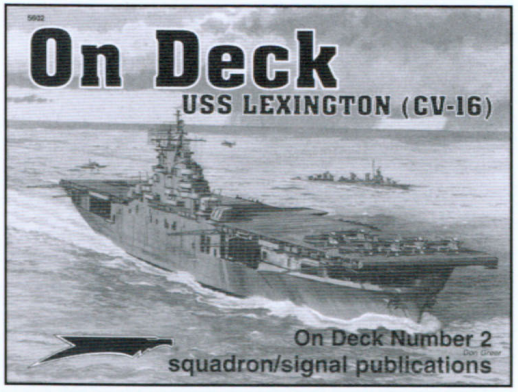


4025 Japanese Light Cruisers

4026 Japanese Heavy Cruisers



5601 USS *Alabama* On Deck



5602 USS *Lexington* On Deck

For more information on squadron/signal books, visit www.squadron.com

ISBN 0-89747-502-X
90000>
9 780897 475020

▲ The crew of USS *Nassau* (LHA-4) marks the twenty-fifth anniversary of her commissioning in July 2004. The second ship to bear the name, *Nassau* commemorates the target of the US Navy and Marine Corps' first amphibious landing.

▼ USS *Boxer* (LHD-4) launches an LCAC during exercise TALISMAN SABRE in Shoalwater Bay, Australia, in June 2005 as a CH-53E Sea Stallion approaches from aft and a CH-46E Sea Knight takes off forward.